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Analysis of Glucose Contents in Dewaka Banana

Yenni P. Pasaribu*, Ni Luh Sri Suryaningsih and Wahida

Faculty of Agriculture, University of Musamus, Merauke-Papua-Indonesia

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ABSTRACT

Today the problem of limited fuel in the world became very important since its raw materials that derived from fossil has started became extinct. Bioethanol is an alternative fuel that has potential tore place fossil fuels, it is a result from the process of biomass that fermented by microorganisms. The raw material for bioethanol production is usually a sugary, starchy and fibrous material. *Dewaka* bananas mostly grow in Merauke area, it tastes slightly sour and it makes this banana excluded than other types of bananas. This reason makes *Dewaka* bananas disregarded. Thus it is necessary to investigate the levels of glucose that can be converted into bioethanol from the waste part of *Dewaka* banana such as the banana leaves, pseudo-stem, hump, and a mixture of all of the three (composite). Glucose contents can be seen through a series of tests in the laboratory. The test was performed in the laboratory of chemical engineering, state polytechnic of Makassar. Glucose contents were determined by the acid hydrolysis, using hydrochloric acid (HCl). The optimum concentration of hydrochloric acid is 1.5 N HCl, the optimum temperature of hydrolysis *Dewaka* banana's flour is at 90 degrees Celsius, while the optimum hydrolysis time of *Dewaka* banana flour is 70 minutes. Banana hump has the highest level of glucose, 49.74 %; hence, the banana hump is feasible to be fermented to produce bio-ethanol.

KEYWORDS: *Dewaka* banana, bioethanol, hydrolysis, glucose contents

INTRODUCTION

Indonesia is an archipelago country and rich of various species of flora and fauna. With such beauties, each island has a hall mark of local plants as well as from the island of Papua. Banana plants are often found in tropical regions, such as Indonesia. Banana plants in Indonesia have various types, characteristics, and flavor. Banana plants have various species, one example is *Dewaka* banana located in Merauke, South Papua. *Dewaka* banana has a distinctive taste, which taste is slightly sour when it's ripe, and it can be used as an alternative fuel that previously was not widely used. This banana plants mostly found in Merauke since its number is plenty there, so the *Dewaka* banana is fairly easy to obtain. Thus, the stem and also the hump can be produced in large quantities there fore the plants has double benefits. [1][2]. *Dewaka* bananas that grow in Merauke, has a slightly sour taste then often makes the banana become the second choice compared with a similar type of banana, kepok bananas. During this time, these *Dewaka* bananas are used by the house hold industry in making banana chips, especially the unripe *Dewaka* bananas. Meanwhile, the banana flour is still on the ongoing research. The banana flour is also another alternative that can be used from *Dewaka* banana. [3][4]

Now, fuel that made from fossil is extinct, so the use of these types of fuels hould gets serious attention. Various research on bioethanol has been done by many countries but until now is almost none could be realized. The use of *Dewaka* banana plants for fuel is on going. Bioethanol is an alternative fuel that potentially changes the old fuel. Bioethanol is the result of the fermentation of biomass than by the help microorganism. [5][6]7][8] The raw material for bioethanol production is sugary, starchy and fibrous material. Therefore, for materials that have those characteristics can be utilized. There has been a lot of researches about bioethanol production from raw materials such as from cassava, sweet potato, sago, corn, molasses, and other similar waste such as banana hump and bark cassava that mostly find in Indonesia. [5][9]

The slightly sour taste encourages researchers to take advantage of the *Dewaka* banana flour as a source of alternative energy. Therefore, in 2013, there was a research that assessed the contents of ethanol that can be obtained from *Dewaka* bananas. The results of the gas chromatography analysis showed the contents of bioethanol of *Dewaka* banana around 83.43 %, then, the better result is expected in recent research. [10]
The abundance of banana production in Merauke also produces abundant residual plant material that has not been utilized very well. This prompted researchers to conduct further studies on the utilization of the rest of the *Dewaka* banana plant into alternative energy sources such as bioethanol. Prior to glucose by acid hydrolysis using hydrochloric acid, therefore it is necessary. [11]

MATERIALS AND METHODS

The methods of conducting this study is in the laboratory, by making parts of sections that were analyzed by some samples, the study prepared the banana flour namely banana leaves, banana stems and banana humps

***Corresponding Author:** Yenni P. Pasaribu, Faculty of Agriculture, University of Musamus, Merauke-Papua-Indonesia.
Email: pasaribuyenni@yahoo.com

that is done in the agrotechnology laboratory of the Musamus University of Merauke, while, the sample is tested in the laboratory of chemical engineering of state polytechnic, Makassar. The location of laboratory of chemical engineering of state polytechnic, Makassar is quite far from Merauke, but it did not discourage researchers to conduct this research.

The materials used in this study are part of the *Dewaka* banana plant which includes banana leaves, banana stems and banana humps that everything is processed into flour before analyzed. Besides the three sections, the other samples contained a mixture of the three sections is as the same ratio as the composite. Some of consumable materials are also used when the samples tested. Materials and samples are from two different age of banana plants, *Dewaka* banana plants that have fruit; approximately 1.2 years old and young *Dewaka* banana plants approximately one year old. This study uses some equipment for preparing and testing of samples, as well as stationery.

The process of acid hydrolys is analysis hydrolysis of banana stem flour, (2). Determination of glucose by the *Luff Schoorl Method* in percentage, (3). Determination of the optimum temperature of hydrolysis of banana stem flour begins from the lowest temperature to the highest temperature, (4). Determination of the optimum concentration of hydrochloric acid (HCl) in the hydrolysis of banana pseudo-stems flour to determine the ethanol content begins with these sequence of events as follows, (1). Determination of the optimum time of ғ is the hydrolysis of banana pseudo-stems flour, and then (5). Hydrolysis of various samples at the optimum conditions

RESULTS AND DISCUSSION

The production of bioethanol from materials that has carbohydrates begins with the process of converting carbohydrates; the cellulose and the starch into glucose. Hydrolysis of carbohydrate is the breakdown of starch polymer or cellulose into monomers such as glucose, as describe in the following chemical formula:

$$(C_6H_{10}O_5)_n + nH_2O \xrightarrow{hidrolisis} n(C_6H_{12}O_6)$$

This study uses acid hydrolysis is by using hydrochloric acid (HCl) with the determination of glucose contents using *Luff Schoorl Methods*. The determination of glucose is done to all parts of the *Dewaka* banana; i.e. banana leaves, pseudo-stems, and humps and a mixture of all three. The previous similar study had already used the fruit of *Dewaka* banana as the research object. [10]

The analysis to determine the optimum conditions of hydrolysis is conducted with a variety of hydrolysis time, hydrolysis temperature, and the concentration of hydrochloric acid (HCl) to the banana pseudo-stems. First, the analysis was conducted to determine the optimum hydrolysis time with time variations ranging from the shortest to the longest time, 20, 50, 70, 90, and 110 minutes. Results of the analysis can be seen in Table 1 below. Table 1 Results of the optimum time analysis in the hydrolysis of banana pseudo-stems flour, as follows:

Table 1 Results of the optimum time analysis in the hydrolysis of banana pseudo-stems flour

No.	**Hydrolysis Time (second)**	**Weight of flour (mg)**	**Sum of Glucose (mg)**	**Content of Glucose (%)**
1.	30	2,500.0	11.45	9.16
2.	50	2,500.1	14.85	11.86
3.	70	2,500.0	15.60	12.46
4.	90	,500.4	11.35	9.06
5.	110	,501.3	9.15	7.30

Source: Result of data processing (2015)

Furthermore, the analysis to determine the optimum temperature is ranging from 60, 70, 80, 90, up to 100 degrees Celsius. While to measure the optimum concentration of hydrochloric acid (HCl) it is conducted with the variation of hydrochloric acid concentration (HCl) from 0.5 N, 1.0 N, 1.5 N, 2,0 N, 2,5 N. The results can be seen in the Table 2 and Table 3. Table 2 Results of the optimum temperature analysis in the hydrolysis of banana pseudo-stems flour and Table 3. Results of the concentration of optimum hydrochloric acid (HCl) analysis in the hydrolysis of banana pseudo-stems flour, as follows:

Table 2 Results of the optimum temperature analysis in the hydrolysis of banana pseudo-stems flour

No.	Temperature (^oC)	Weight of flour (mg)	Sum of glucose (mg)	Content of glucose (%)
1.	60	2500,0	15,60	12,46
2.	70	2532,0	17,35	13,69
3.	80	2504,0	18,90	15,09
4.	90	2526,0	27,75	21,96
5.	100	2552,0	25,15	19,69

Source: Result of data processing (2015)

Tabel 3 Results of the concentration of optimum hydrochloric acid (HCl) analysis in the hydrolysis of banana pseudo-stems flour

No.	Concentration of HCl (N)	Weight of flour (mg)	Sum of glucose (mg)	Content of glucose (%)
1.	0.5	2,526.0	27.75	21.96
2.	1.0	2,540.0	53.15	41.85
3.	1.5	2,520.0	55.55	44.09
4.	2.0	2,556.0	50.35	39.01
5.	2.5	2,528.0	44.65	35.31

Source: Result of data processing (2015)

Table 1 Results of the optimum time analysis in the hydrolysis of banana stems flour showed that the optimum time in the process of hydrolysis of banana stem flour is at 70 minutes. The optimum temperature hydrolysis of *Dewaka* banana flour is at a temperature of 90 degrees Celsius. Table 2. Results of the optimum temperature analysis in the hydrolysis of banana stems flour, while the optimum concentration of hydrochloric acid (HCL) of hydrolysis *Dewaka* banana stems flour is 1,5 N (it can be seen in Table 3). Table 3 Results of the concentration of optimum hydrochloric acid (HCl) analysis in the hydrolysis of banana stems flour.

The optimum condition is as the same as the results of previous research on *Dewaka* banana flour [10], so that the optimum conditions can be used to do the hydrolysis to other parts of the tree namely the leaves, humps, and the composites. The hydrolysis is conducted to all parts of *Dewaka* banana plant to determine the glucose contents of all parts by determining the different ages of the plants. The part of the plant that has the highest glucose will be fermented into bioethanol. The hydrolysis of all parts of the plants that was 12 months and 14 months seen in Table 4. Table 4 Results of the analysis of glucose contents in all parts of the banana plants.

Table 4 Results of the analysis of glucose contents in all parts of the banana plants

No	Age of trees	Kind of samples	Weight of samples (mg)	Sum of glucose (mg)	Content of glucose (%)
1	14 months (after have fruits)	Leaf 1	2501.0	23.85	19.06
2		Leaf 3	2500.0	21.50	17.19
3		Pseudo Stems 1	2501.0	55.55	44.09
4		Pseudo Stems 3	2503.0	38.25	30.56
5		Humps 1	2501.0	62.20	49.74
6		Humps 3	2501.0	62.20	49.74
7		Composites 1	2504.0	38.65	30.86
8		Composites 3	2502.0	47.25	37.77
9	12 months (after have fruits)	Leaf 2	2500.0	22.10	17.71
10		Leaf 4	2500.0	25.15	20.10
11		Pseudo-Stems 2	2504.0	38.25	30.54
12		Pseudo-Stems 4	2504.0	44.05	35.19
13		Humps 2	2500.0	62.20	49.76
14		Humps 4	2502.0	62.20	49.72
15		Composites 2	2501.0	35.85	28.66
16		Composites 4	2500.0	41.75	33.39

Source: Result of data processing (2015)

The results showed that glucose contents in both age groups are not different, therefore the use of banana plants as a source of bioethanol can be done before the plants has fruit or not. If the fruits are used as other products, then the other parts of the plants is waste that can be used as the source of bioethanol. While the lowest glucose contents contained in the banana leaves, banana stems, banana humps, and the composites.

The leaves are the part that has the lowest glucose contents at both of the plants age. This is because the leaves contain high cellulose, hemi-cellulose, and lignin. It is hard to produce glucose from materials that have cellulose and lignin. Hemi-cellulose binds the sheets of cellulose fibres and cross linked with lignin become a complex structure and it makes the hydrolysis difficult. The chemical composition of banana plants can be seen in Table 5 Chemical composition of banana plants.

Table 5 Chemical composition of banana plants

Component (%)	Leave	Stem	Hump	Fruit and Leather [8]	Leather [4]
Dry Material	17.5-24,3 [2],[1],[8]	3.6-9.8 [6],[7]	6.2-13.87 [1]	20.9-21.2	14.08-18
Course fiber	22.6 [1]	13.4-31.7 [1],[7]	9.99-16.1 [1]	4-5.2	15.32-26.7
Cellulose	20.5-23.5 [2]	19.7-35.2 [6],[7]	-	-	-
Hemi-cellulose	17.1-24.2 [2],[1]	4.9-18.7 [1],[7]	-	-	-
Lignin	4.5-10.4 [1]	1.3-9.2 [6],[7]	8.8 [1]	-	-

Source: Result of data processing (2015)

Banana stems are mostly filled with water and fibre. The results showed the water of the banana stems are high (93.415 %) so it is hygroscopic. Besides high water content, banana stems contain crude fiber and cellulose that is high enough so that it can be used as an alternative raw material in making bioethanol [3]. The results showed that the stems of *Dewaka* banana produce high contents of glucose, around 30-44 %. banana stems has lower contents of hemi-cellulose than in the leaves so it is more easily hydrolysed by acid. However, the high contents of water make the dry material few.

Banana hump is a waste that has high starch. It resemble sago starch and tapioca. Banana hump has a composition of 76 % starch, 20 % water, the rest is protein and vitamin [11]. The results showed that the banana hump contains the highest glucose level that is 49.74 % both in banana plants that have not been fruitful (12 months) and have fruit (14 months). Several studies have been conducted to determine the ethanol content of banana hump. A research conducted [9] states that banana hump can be fermented by *saccaromycess cereviceae* yeast, with the highest ethanol content in the use of starter 8 % and by 5 days fermentation that is equal to 912.9003 ml of ethanol per kg of banana hump with the conversion of glucose into ethanol amount to 88.77214 % mol. Banana hump contains starch, without cellulose and hemi-cellulose so it is easily hydrolyzed become glucose. High glucose contents makes banana hump has potential to be processed in to bioethanol through fermentation process.

CONCLUSION

The age of *Dewaka* bananas has no effect on glucose contents in parts of the banana plant. The glucose contents of both bananas are almost the same. The average part of the plant which has the highest glucose contents are humps (49.74 %), compared to the leaves (18.52 %), stems (35.10 %) and composite (32.67 %). The glucose hydrolysis using hydrochloric acid (HCl) is sufficiently high so that the banana content is potential to be processed in to bioethanol through fermentation process. To determine the possibility of a different outcome then it is advisable to do similar research using enzymatic hydrolysis.

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