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# Dewaka Banana As An Alternative Energy Source

Ni Luh Sri Suryaningsih[a]* and Yenni Pintauli Pasaribu[b]

[a]*Faculty of Agriculture, Musamus University, Kamizaun Street, Mopah Lama, Merauke, 99611*
[b]*Faculty of Teacher, Training, and Education, Musamus University, Kamizaun Street, Mopah Lama, Merauke, 99611*

**Abstract**

Dewaka's banana grows well and abundant bananas production in Merauke area, but with a little bit sour taste when they're ripe made this bananas often the second choice compared to another kind of bananas. The research has been conducted to determine concentration of bioethanol produced from dewaka's banana flour. Banana flour was obtained from crused the slices of dried bananas. Then concentration of ethanol can then be identified through a series of tests in the laboratory. The results of gas chromatographic analysis show that dewaka banana can be used as an alternative energy source with bioethanol content of 83.43%. The concentration was result of 5 (five) days fermentation with yeast. The hydrolysis which is used was acid hydrolysis, using hydrochloric acid. The optimum concentration of hydrolysis was 1.5 N HCl, the optimum temperature was $90^0$C, whereas the optimum hydrolysis time was 70 minutes.



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*Keywords:* banana, dewaka banana, bioethanol.

## INTRODUCTION

The world is lack of fuel because fuel from fossil is less. Bioethanol is an alternative to sustitute the function of fuel. Bioethanol is an ethanol as the result of fermentation from biomass by helping of microorganism.

The raw material for bioethanol production was sugary ingredients, starchy and fibrous. Many reseaches have been done to make bioethanol from raw material such as cassava, sweet potato, sago, corn, molasses/drops and other wastes (banana weevil and cassava's bark), such as made by Nurdyastuti [2] and Solikhin [1].

Dewaka's banana grew well and abundant bananas production in Merauke area, but with a little bit sour taste when they're ripe made this bananas was often the second choice compared to another kind of bananas, such as

* Corresponding author.
*E-mail address:*niluhsris@gmail.com


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kepok bananas. For today, unripe dewaka has been used in household industry as banana chips.

Another function of this banana was to make flour, but is still in the current study. But the sour taste of Dewaka's made the to used the flour as alternative energy sources. That's why the concentration of ethanol from dewaka's banana flour was need to know.

This study was aimed to determine the concentration of ethanol in dewaka's banana flour. This research was expected to obtain the availability of alternative energy sources, because of some dewaka banana was expelled caused it have sour taste.

## MATERIALS AND METHODS

The study was conducted at several locations, in Laboratory at Faculty of Agriculture, Musamus University such as the preparation of Dewaka's flour sample. The preparation was done twice, in August 2013 and October, 2013. In August 2013, the sample was sent to the Teknologi Pangan dan Hasil Pertanian laboratory, Faculty of Agricultural Technology, Gadjah Mada University for determinated proximate analysis and reduction sugars. Another sample was sent to Politeknik Negeri Makassar laboratory to analize the hydrolysis of glucose to the determination of ethanol in this flour.

The materials which were used in this study are banana flour, yeast, and some consumable materials for testing samples. The device used was devices at preparation, testing sample and stationery. The yeast which is used in this study was fermipan (trademark of *Saccharomyces cerevisiae*).

Banana's flour was sent to Teknologi Pangan dan Hasil Pertanian laboratory and Politeknik Negeri Makassar laboratory for determinated proximate analysis, reduction sugar and bioethanol concentration. The cycle of the analysis consisted of : determination of optimum concentration of HCl in the hydrolysis of banana flour [1], determination of glucose content with Luff Schoorl method [2], determination of optimum temperature of hydrolysis [3], the optimum time of hydrolysis [4], the determination of glucose content before hydrolysis (Luff Schoorl method) [5], determination of glucose content to determine the optimum fermentation time [6], and to produce bioethanol depend on the optimum condition of fermentation [7].

The data which is taken was data of proximate, reduction sugar and concentration of bioethanol.

## RESULTS AND DISCUSSION

Before doing the hydrolysis analysis to get bioethanol, the proximate analysis has done first to know the main content of the materials such as water, ash, fat, protein, carbohydrate, crude fiber and calories of dewaka banana flour. Beside that, sugar reduction analysis was also performed to determine whether the material could be converted into bioethanol. Proximate analysis result and reduction sugar from the study can be seen in Table 1.

Table 1. The Proximate and Sugar Reduction Results.

| Analysis | Average (%) |
|---|---|
| Water content | 10.265 |
| Ash | 2.721 |
| Fat | 0.555 |
| Protein fk:6,25 | 4.025 |
| Carbohydrate by diff | 82.435 |
| Crude fiber | 4.947 |
| Calories (Cal/100 gr) | 347.605 |
| Reduction sugar | 11.755 |

Production of ethanol / bio-ethanol (alcohol) with raw materials consist of starch or carbohydrate was done by carbohydrates conversion into water disolves glucose. Glucose can be made from starches whereas the making process can be differenciated depend on the helping essense which is used, such as acid hydrolysis and enzyme hydrolysis. Acid hydrolysis using hydrochloric acid (HCl) to point out the glucose content by using the Luff Schoorl method.

Next step was the process of fermentation or fermentation of sugars to ethanol by adding yeast. Reactions that occur in the production process of ethanol / bioethanol is simply shown in reactions 1 and 2.

$$\underset{\text{(starch)}}{H_2O(C_6H_{12}O_6)_n} \longrightarrow \underset{\text{(glucose)}}{(C_6H_{12}O_6)_n} \quad \text{..... (1)}$$

$$\underset{\text{(glucose)}}{(C_6H_{12}O_6)_n} \xrightarrow[\text{Yeast}]{} \underset{\text{(ethanol)}}{2\ C_2H_5OH} + 2\ CO_2 \quad \text{..... (2)}$$

As have discribed in this research, it used acid hydrolysis by hydrochloric acid (HCl). The first analyzing was to determine the optimum HCl concentration which is going to be used. HCl concentration was 0.5 N, 1 N, 1.5 N, 2 N and 2.5 N, the analytical results are listed in Table 2.

Table 2. The Optimum Concentration of HCl Hydrolysis Result.

| No. | HCl Concentration (N) | Flour weight (mg) | Amount of glucose (mg) | Glucose content (%) |
|---|---|---|---|---|
| 1 | 0.5 | 2,531.20 | 25.50 | 40.33 |
| 2 | 1.0 | 2,529.50 | 45.80 | 72.42 |
| 3 | 1.5 | 2,525.50 | 56.75 | 89.93 |
| 4 | 2.0 | 2,532.70 | 50.90 | 80.39 |
| 5 | 2.5 | 2,528.60 | 48.70 | 77.03 |

Then the analysis was conducted for optimum temperature and time of hydrolysis. The temperature of the acid hydrolysis was conducted between 60 to 100$^0$C, with a temperature range of 10$^0$C. The hydrolysis time was conducted at 30 minutes, 50 minutes, 70 minutes, 90 minutes and 110 minutes. The results of the analysis are presented in Table 3 and Table 4.

Table 3. The Optimum Temperature of Hydrolysis.

| No. | Temperature ($^0$C) | Flour weight (mg) | Amount of glucose (mg) | Glucose content (%) |
|---|---|---|---|---|
| 1 | 60 | 2,500.60 | 11.75 | 18.72 |
| 2 | 70 | 2,501.60 | 27.35 | 43.72 |
| 3 | 80 | 2,501.80 | 38.65 | 61.78 |
| 4 | 90 | 2,525.50 | 56.75 | 89.93 |
| 5 | 100 | 2,501.70 | 51.05 | 81.65 |

Table 4. The Optimum Time of Hydrolysis

| No. | Hydrolysis time (minute) | Flour weight (mg) | Amount of glucose (mg) | Glucose content (%) |
|---|---|---|---|---|
| 1 | 30 | 2,506.30 | 47.40 | 75.64 |
| 2 | 50 | 2,502.00 | 52.55 | 84.01 |
| 3 | 70 | 2,525.50 | 56.75 | 89.93 |
| 4 | 90 | 2,500.60 | 53.15 | 85.02 |
| 5 | 110 | 2,500.50 | 50.75 | 81.18 |

Table 2 shows that the optimum concentration of HCl in the hydrolysis process was at 1.5 N. The optimum temperature hydrolysis was at $90^0$C (Table 3), whereas for the optimum hydrolysis time was 70 minutes (can be seen at Table 4).

After the three of analysis are done, the process was followed by analysis to determine glucose content before hydrolysis and determination of glucose fermentation for optimum conditions, i.e. concentration of 1.5 N HCl, $90^o$C temperature, and time of 70 minutes. The results showed that glucose content before hydrolysis was 1.65% and glucose for fermentation is 82.24%.

The analysis was then followed by the manufacture of fermented solution. This solution was then fermented with yeast for 1 to 6 days. Bioethanol results have been obtained from a solution that has been fermented and then distilled. Then the ethanol content of banana flour was known based on testing with a refractometer and gas chromatography. The test results showed that the fermentation time 5 (five) days to have the highest levels of ethanol 24% (see Table 5).

Table 5. Time of Fermentation and Bioethanol Concentration.

| No. | Fermentation time (day) | Solution volume (ml) | Distillate volume (ml) | Bioethanol index of refraction | Bioethanol concentration (%) | Explanation |
|---|---|---|---|---|---|---|
| 1 | I | 160 | 15 | 13,406 | 19.20 | |
| 2 | II | 160 | 15 | 13,418 | 21.60 | |
| 3 | III | 160 | 15 | 13,422 | 22.40 | |
| 4 | IV | 160 | 15 | 13,426 | 23.20 | |
| 5 | V | 160 | 15 | 13,430 | 24.00 | Optimum |
| 6 | VI | 160 | 15 | 13,427 | 23.40 | |

Table 6. Gas Chromatograpy Analyzed

| | Area |
|---|---|
| Sample of fermentation product | 182880560 |
| Standard ethanol | 216575627 |

Ethanol concentration was determined by using gas chromatography. The peak area data obtained as shown in the following table. Then the content of bioethanol fermentation products can be calculated by compare the peak

area of the sample of fermentation product to standard ethanol, with the following calculation: Bioethanol concentration of product = (182880560/216575627) x 99,98 % = 84,43 %. The result of calculation shows that the content of bioethanol fermentation products was 84,43%.

## CONCLUSION

Dewaka banana can be used as an alternative energy source with bioethanol concentration of 84.43% from the results of gas chromatographic analysis. The ethanol content of a fermented for 5 (five) days with a fermentation material fermipan. The hydrolysis which is used was acid hydrolysis using hydrochloric acid. The optimum concentration was 1.5 N HCl, the optimum temperature hydrolysis was at $90^0$C, while for the optimum hydrolysis time was 70 minutes.

Furthermore, it is necessary to do further analysis on the part of others such as banana stems and leaves were harvested after not being used anymore.

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