Conversion Of Sugar Cane Bagasse become Bioethanol Using Variations Of Yeast Types And Fermentation Temperatures With Socarification Process

by Lely Meilani , Kiagus. A Roni Atikah, Netty Herawati

Conversion Of Sugar Cane Bagasse become Bioethanol Using Variations Of Yeast Types And Fermentation Temperatures With Socarification Process

Lely Meilani , Kiagus. A Roni, Atikah, Netty Herawati
Chemical Engineering Study Program, Faculty of Engineering, Muhammadiyah University, Palembang
Jalan Jendral Ahmad Yani 13 Ulu, Plaju, Palembang

Abstract-Sugarcane bagasse is a waste of sugar factories and one of its lignocellulosic materials is still of limited use. Sugarcane bagasse consists of three main components, namely cellulose, hemicellulose, and lignin. Sugarcane bagasse can be converted into bioethanol through a hydrolysis process (the process of converting carbohydrates into glucose) which consists of a liquefaction and saccharification process and followed by a fermentation process . The hydrolysis method is carried out enzymatically. This research used alpha amylase and gluco amylase enzymes with various types of yeast including Saccharomyces cerevisiae , Rhizopus oryzae, Acetobacter xylinum, Mucor sp, and A spergilus niger varied with liquefaction temperatures including 80, 85, 90, 95, and 100 o C. Obtained the most optimal yeast is Saccharomyces cerevisiae with an optimal temperature of 95 o C resulting in a bioethanol concentration of 4.5%.

Keywords: Bioethanol, hydrolysis, fermentation, bagasse, s accharomyces cereviceae

Preliminary

Sugarcane bagasse is a waste of sugar factories and one of its lignocellulosic materials is still of limited use. Sugarcane bagasse is used by sugar factories as boiler fuel for turbine propulsion which is the main electricity provider for the continuity of the process at the factory. Sugarcane bagasse consists of three main components, namely cellulose, hemicellulose, and lignin. Based on data from the Indonesian Sugar Plantation Research Center (P3GI), bagasse produced at the Sugar Mill is 32% of the weight of the sugarcane that is ground. 60% of the sugarcane bagasse that has been used as boiler fuel is produced. Therefore it is estimated as much as 40% of the sugarcane bagasse has not been utilized (Husin in Oktavia, 2014).

Energy needs in Indonesia at this time are still largely supplied from fossil fuels. The need for fuel that continues to increase makes the supply of fossil fuels in the world, especially Indonesia, decreasing. This situation increasingly emphasizes the importance of research on alternative energy substitutes for fuels, including bioethanol. Bioethanol has better characteristics compared to gasoline because it can increase combustion efficiency (Hambali et al, 2007) and reduce greenhouse gas emissions (Costello and Chum, 1998).

Bioethanol is ethanol obtained from the fermentation process of carbohydrate or lignocellulosic materials using the help of microorganisms. Bioethanol can be made from three types of raw materials, namely fibrous material (cellulose), materials containing sucrose, and materials containing starch such as grains. In general, the process of making bioethanol begins with the hydrolysis process and the fermentation process. Hydrolysis process is the process of decompositionof a polysaccharide compound with water. Sugarcane bagasse is a waste of sugar factories and one of the lignocellulosic materials which is still limited in use. Sugarcane bagasse is used by sugar factories as boiler fuel for turbine propulsion which is the main electricity provider for the continuity of processes in the factory. . Sugarcane bagasse consists of three main components, namely cellulose, hemicellulose, and lignin. Based on data from the Indonesian Sugar Plantation Research Center (P3GI), bagasse produced at the Sugar Mill is 32% of the weight of the sugarcane that is ground. 60% of the sugarcane bagasse that has been used as boiler fuel is produced. Therefore it is estimated as much as 40% of the sugarcane bagasse has not been utilized (Husin in Oktavia, 2014).

Energy needs in Indonesia at this time are still largely supplied from fossil fuels. The need for fuel that continues to increase makes the supply of fossil fuels in the world, especially Indonesia, decreasing. This situation increasingly emphasizes the importance of research on alternative energy substitutes for fuels, including bioethanol. Bioethanol has better characteristics compared to gasoline because it can increase combustion efficiency (Hambali et al, 2007) and reduce greenhouse gas emissions (Costello and Chum, 1998).

Bioethanol is ethanol obtained from the fermentation process of carbohydrate or lignocellulosic materials using the help of microorganisms. Bioethanol can be made from three types of raw materials, namely fibrous material (cellulose), materials containing sucrose, and materials containing starch such as grains. In general, the process of making bioethanol begins with the hydrolysis process and the fermentation process. Hydrolysis process is a process of decomposition of a compound polysaccharide with water so that the compound is broken and decomposed into monosaccharides (glucose). Fermentation is a microbiological process where the decomposition of complex compounds becomes simple with the help of microorganisms so as to produce energy (Perry et al, 1999).

The hydrolysis process is a process used to obtain high glucose levels. Several ways of cellulose hydrolysis are enzymatic hydrolysis, dilute acid hydrolysis, and concentrated hydrolysis. Enzymatic hydrolysis using enzymes, while the concentrated acid hydrolysis using high concentrations of acid, such as HCl 40% (w / w), H_2SO_4 60% (w / w) or HF 90% (w / w). According to Rohajatien in Kardono (2010) hydrolysis using sulfuric acid (H_2SO_4) is able to produce a greater yield than using hydrochloric acid (HCl).

Corresponding Author: Lely Meilani , Email: kiagusaroni@gmail.com
Article History: Received: July 03, 2019, Accepted: Sep 26, 2019

The hydrolysis process is one of the most important stages, because this process aims to produce as much glucose as possible, where glucose is the material to be fermented into ethanol. The catalyst used is sulfuric acid because it can produce higher yields compared to the hydrochloric acid catalyst. Therefore, researchers are interested in studying the kinetic reaction of sugarcane bagasse hydrolysis reaction with sulfuric acid catalyst to determine the optimum glucose levels obtained through the hydrolysis process in the process of making bioethanol.

In a study conducted by Nova Indrayani et al with variable liquidation temperatures of 75 o C, 85 o C and 95 o C. For the temperature of 75 o C, the highest productivity value obtained at 24 hours fermentation time is 3% or 30 g / L. At 85 o C, the highest productivity value obtained at 24 hours is 5% or 50 g / L. Meanwhile, at a liquidation temperature of 95 o C, the highest productivity was obtained at an ethanol concentration of 5% or 50 g / L with a 24-hour fermentation time (Nova Indrayani, 2016) 9 .

Research by Jhonprimen HS et al., About the effect of yeast type on bioethanol fermentation process for 3 days using variables in bread yeast with a mass of 5, 7, 10 grams , resulting in ethanol levels which tended to increase, respectively 13.73% , 19.22% and 20.37%. In the yeast tape with a period of 5, 7 , 10 grams produce ethanol levels that tend to increase, namely 18.05%, 19.67%, and 24.01% (Jhonprimen HS et al, 2017) 10 .

From the research that has been done, we can see important variables that can influence the acquisition of bioethanol. Therefore, this study aims to obtain the most optimal type of yeast and its concentration and obtain liquefaction temperature and fermentation time.

Research Methodology

Bioethanol production is carried out in several stages, namely hydrolysis (liquifaction and saccharification), fermentation, and distillation.

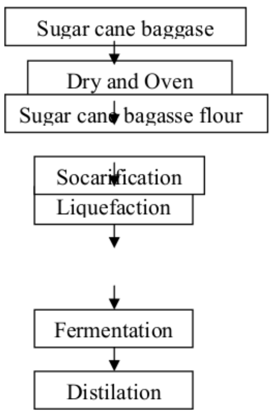


Figure 1. Schema of Making Bioethanol

The materials used in this study is bagasse , the enzyme alpha amylase , an enzyme glucoamylase , a solution luff-schrool, H 2 SO 4 , distilled water , Saccharomycescerevisiae, rhizopus oryzae, acetobacterxylinum, Mucor sp, and aspergillus niger. While the equipment used in this study is a set of fermentors, a set of distillation devices, 10 ml and 25 ml measuring pipettes, rubber balls, universal indicators, 250 ml and 500 ml beakers, 100 ml measuring cups, drop pipettes , stirrers, neck flasks three, 100 ml and 250 ml pumpkin, watch glass, 250 ml and 1000 ml erlenmeyer, hotplate, magnetic stirer, 100 o C thermometer , boiling stone, and analytical balance .

Results And Discussion

In the manufacture of bioethanol from sugarcane bagasse , before the fermentation stage is carried out, a sugar concentration test is carried out using a luff-schoorl solution. The results of the analysis can be seen in the following table.

Table 1. Sugar Concentrations in Sugarcane Bagasse

Liquifaction Temperature (OC)	Sugar Concentration (g / L)
80	11, 399
85	11, 928
90	12, 505
95	13, 899
100	12, 569

From the table above it can be seen that in the temperature range of 80-95 O C the concentration of sugar has increased in concentration, whereas when temperature is increased to 100 O C the concentration of sugar has decreased. It can be said that the temperature of liquefaction optim al in pembentuka n sugar at a temperature of 95 o C is equal to 13 899 %. In the graph increases and decreases n the concentration of sugar can be seen in the following figure.

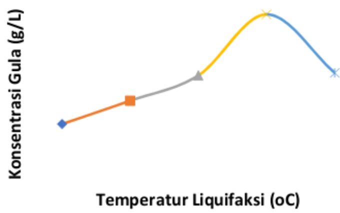


Figure 2. Effect of Liquifaction Temperature on Sugar Concentration

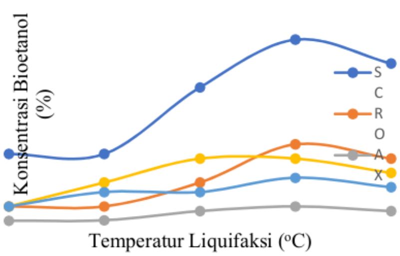
Yeast type	Concentration of Bioethanol (%) with Liquifaction (°C) Temperature Variation				
	80	85	90	95	100
SC	2 , 1	2 , 1	3 , 5	4 . 5	4
RO	1	1	1, 5	2 , 3	2
AX	0.7	0, 71	0, 9	1	0.9
M	1	1.5	2	2	1.7
AN	1	1, 3	1, 3	1.6	1, 4

Effect of Yeast Type on Bioethanol Concentration with Liquifaction Temperature Variation

Table 2. Obtaining Bioethanol with Variations in Yeast Types and Liquifaction Temperature

Information :
SC : *Saccharomyces cerevisiae*
RO : *Rhizopus oryzae*
AC : *Acetobacter xylinum*
M : *Mucor sp.*
AN : *Aspergilus niger*

Each variable has a different result. Bioethanol acquisition data which is influenced by the type of yeast and the temperature of the liquefaction can be seen in Figure 3.



From Figure 3 it can be seen that in this process with variations in the types of yeast to liquefaction temperatures (°C) 80 °C and 85 °C obtained the highest bioethanol concentration using yeast *Saccharomyces cerevisiae,* at liquefaction temperatures 9 0 °C and 95 °C has increased ethanol concentrations respectively obtained bioethanol concentration 3.5 % and 4 .3 % . Because according to Groggins 1958, by using a higher temperature the time can be maximized. However, when the liquefaction temperature is increased by 5 °C, the bioethanol yields are decreased.

In this study a comparison of the types of yeast used in the fermentation process. *The* chosen *Saccharomyces cerevisiae* is *Saccharomyces cerevisiae* which has the ability to ferment sugar well in the dough and can grow quickly. So that by using bread yeast it is more optimal to do fermentation in a short time. Whereas in yeast tape is less optimal, it is caused by the yeast used is not pure culture , but is a mixture of genera, has species such as *Aspergilus, S. Cerevisiae, Candida* and *Hansenula* , and *Acetobacter* .

This happens because at a temperature of 100 °C is in line with the amount of sugar concentration that is getting reduced. Sugar is a transition product before the product turns into biethanol. When the activity of breaking down sugar that occurs at a temperature of ^{100oC} occurs so slowly. This happens because the activity of enzymes that break down

*Corresponding Author: Lely Meilani , Email: kiagusaroni@gmail.com
Article History: Received: July 03, 2019, Accepted: Sep 26, 2019

complex carbohydrates into simple carbohydrates becomes more decreased because the enzymes used work optimally at a temperature of 95 ^{o}C.

Conclusion

Based on research that has been done, it can be concluded that the temperature optimal liquefaction that is 95 ^{o}C with a concentration g ula generated is 13.899 g / L and obtain concentrations of bioethanol highest ie 4.5% by using the yeast *Saccharomyces cerevisiae* .

References

[1] Ministry of Foreign Affairs of the Republic of Indonesia . 2019. Sustainable Energy and National Energy Security . https://kemlu.go.id . Accessed July 3, 2019.

[2] Ministry of Energy and Mineral Resources. 2018. Energy Conservation Is Not Just Energy Saving . https://www.cnnindonesia.com . Accessed July 3, 2019.

[3] Arlianti, Lily. 2018. Bioethanol as a Potential Source of Alternative Green Energy in Indonesia Islamic University: Tangerang Banten.

[4] Diwangkara, Diwya. Bioethanol Production from Sweet Sorghum (Sorghum Bicolor (L.) Moench) Bag by Trichoderma Viride and Saccharomyces Cerevisiae with Simultaneous Fermentation Saccharification Method. Bogor Institute of Agriculture: Bogor.

[5] Pinzon, r. T. & sanyasi, . R. D. L. R. (2018) is there any benefit of citicoline for acute ischemic stroke ? Systematic review of current evidences. Journal of Critical Reviews, 5 (3), 11-14. doi:10.22159/jcr.2018v5i3.24568

[6] Mikal Rekdal, Aravind Pai, Ravi Choudhari, Muddukrishna Badamane Sathyanarayana. "Applications of Co-Crystals in Pharmaceutical Drugs." Systematic Reviews in Pharmacy 9.1 (2018), 55-57. Print. doi:10.5530/srp.2018.1.11

[7] I Mohammad Alibakhshi Kenari, “Ultra Wideband Patch Antenna For Ka Band Applications”,National Journal of Antennas and Propagation, Volume 1, issue 1, 2019

[8] H onprimen HS et al. 2017. Effect of Yeast Mass, Yeast Type, and Fermentation Time on Durian Seed Bioethanol. Srirvijaya University: Palembang.

[9] Rakhmadani Agista Hijri, Sutrisno Endro, & Zaman Badrus. 2011. " Study of Utilization of Food Waste as Ethanol Producing Material for Biofuels Through Hydrolysis Process at Different Stirring Speeds and Fermentation Times ". Environmental Engineering Department. Diponegoro University Faculty of Engineering. Semarang.

Conversion Of Sugar Cane Bagasse become Bioethanol Using Variations Of Yeast Types And Fermentation Temperatures With Socarification Process

ORIGINALITY REPORT

9%	7%	2%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.aspbs.com Internet Source	3%
2	jcreview.com Internet Source	2%
3	www.jcreview.com Internet Source	1%
4	ukipaulus.ac.id Internet Source	1%
5	M Z Adli, Y W Sari, Irzaman. " Extraction Silicon Dioxide (SiO) from Charcoal of Baggase ( ) ", IOP Conference Series: Earth and Environmental Science, 2018 Publication	1%
6	Elfidiah, D Kharismadewi, E Yuliwati. " Wuluh starfruit (.) leaves extract as green corrosion inhibitor in reinforced steel ", Journal of Physics: Conference Series, 2020 Publication	1%

7	Sunhee Lee. "Crystal structure and thermal properties of poly(vinylidene fluoridehexafluoropropylene) films prepared by various processing conditions", Fibers and Polymers, 2011 Publication	1%

Exclude quotes	On	Exclude matches	< 1%
Exclude bibliography	Off		