THE VARIATIONS EFFECT OF FERMENTATION TIME IN MAKING BIOETHANOL FROM BANANA (*Musa paradisiaca*) UNDERGROUND STEM WASTE

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ABSTRACT: The study concerning the effect of variations in the fermentation time of bioethanol making from banana waste has been done. Underground stem waste of the banana plant was used and it can be harnessed into a product with added value. This waste was used as raw material for bioethanol. The most famous process of making bioethanol is the fermentation process. The Banana waste was processed into ethanol through enzymatic hydrolysis, fermentation and distillation. In this study, the variation used was the duration of fermentation time (1 day, 2 days, 3 days, 4 days, and 5 days). The results showed that the highest yield was at 3 days fermentation time with 3.97% ethanol content. Characterization of physical properties test was also carried out on samples that have optimum ethanol levels, including density, viscosity and solubility in water. The obtained densitu at the variation time of fermentation was 0.9961 g /cm3, the viscosity is 0.7517 mm2/sec and water solubility was categorized very soluble.
KEYWORD: bioethanol, banana waste, fermentation time

1. INTRODUCTIONS

Ethanol is an alternative energy source, has excellent prospects as a substitute for liquid fuels with renewable raw materials, environmentally friendly as well as very advantageous macro economic (Sari, 2008). Bioethanol is liquid sugar fermentation process results from carbohydrates (starch) using microorganisms (Anonymous, 2007). The production of bioethanol containing starch or carbohydrate made through the process of converting carbohydrates into sugar (glucose) by several methods such as by acid and enzymatic hydrolysis. Enzymatic hydrolysis method is more commonly used because it is more environmentally friendly. Enzymes used for hydrolysis is endoenzim example, α-amylase and exsoenzim example glucoamylase (Tryphosa, 2007).

Material that has not been widely used as a producer of carbohydrate sources are banana waste. While banana production in Indonesia is quite large, national banana production continues to increase every year and production banana in Indonesia reached 5.1 million tons in 2005 (Directorate General of Horticulture, 2005). Aseegaf (2009) states banana waste has good prospects as a source of bioethanol. Underground stem of the banana is a waste because the banana plants proliferate shoots and bear fruit only once and then die. In 100 grams of wet underground stem banana contains 45 calories, 0.6 g protein, 11.6 carbohydrates, 12 mg of vitamin C and 86 grams of water. The content carbohydrates of the underground stem banana potential as a source of biofuels, namely ethanol (Munadjim, 1983). Praswati (2007) study the utilization of waste bananas for the manufacture of ethanol conclude that the amount of ethanol produced from banana peels kepok as much as 0,017 l / kg with ethanol content 1.98% v / v.

2. METHODOLOGY

Materials. The samples used were planted banana waste in Medan North Sumatera. Underground stem banana 1 kg cleaned, peeled and grated, added as much as 1.5 L of water, stirred and heated at 900C for 30-60 minutes. Added 0.1 ml of the enzyme alpha amylase, cooled to a temperature of 55 - 600C (pH 3,5 - 5,5) with a heat exchanger. Added 0.2 mL glucoamylase, the temperature is kept at a temperature of 55 - 600C (pH 4.0 - 4,5) for 30 minutes, cooled to a temperature of 300C. Added 0.04 g yeast, NPK 0.28 g and 1.3 g urea. Fermented in a closed state, fermented distilled to a temperature of 78-900C. Characterization of bioethanol obtained, include: ethanol content, GC analysis, density, viscosity and solubility in water.

3. RESULTS AND DISCUSSION

Measurement results content of ethanol fermentation time variation, by measuring the ethanol content of fermented underground stem banana kepok on variations of fermentation time for 1 day; 2 days; 3 days; 4 days; and 5 days with the addition of 0.04 g of yeast and three repetitions can be seen in Table.1

Tabel.1. Content of Ethanol From Variations Time Yeast Fermentation with addition of 0.04 g

Fermentation Time (Day)	Content of ethanol (%)			
	I	II	III	Rata-rata
1	0,48	0,95	0,48	0,64
2	0,95	0,95	0,95	0,95
3	3,47	3,90	4,54	3,97
4	0,95	0,95	0,48	0,79
5	1,90	1,90	1,90	1,90

Characterization of Ethanol with the maximum content of ethanol fermentation time variations. Samples that have optimum ethanol concentration of fermentation time variation is characterized physical properties include: density, viscosity and solubility in water.

Table 2. Physical properties of ethanol with the maximum content of fermentation time variation

Characterization	Fermentation Time 3 Day
Density (g/cm^3)	0,9951
Viskosity (cP)	0,7517
Solubility in water	Very soluble

The variation effect of fermentation time of the content ethanol (%), from Table 2. The fermentation time with a variation of one day; 2 days; 3 days; 4 days; and 5 days have optimum point ethanol content in the variation 3 days with ethanol content obtained was 3.97%. While the content of ethanol produced in the fermentation time variation of 1, 2, 4 and 5 days ranged from 0.64 to 1.90%, as shown in Figure 2.

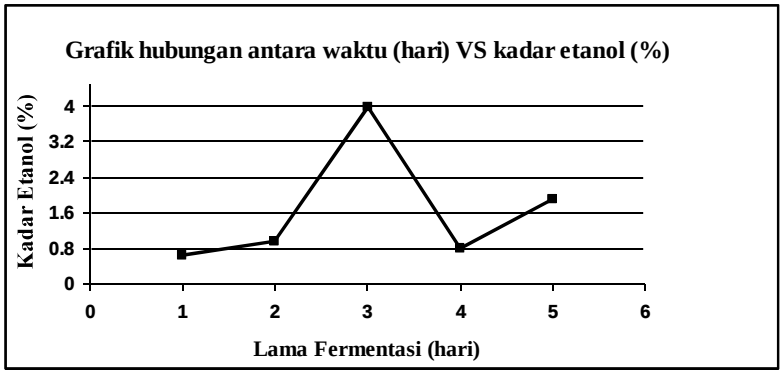

Fig 2. Gaph of relationship between the fermentation time (days) and the content of ethanol (%)

Fig 2. shows the best fermentation time is 3 days with content of ethanol produced 3.97%. Glucose for 3 days already broken down completely into ethanol. According Hartati, Indah, Puji Setyowati and Ratna (1999) the longer the fermentation time, the more the amount of ethanol that is formed. This is due to microbial growth is highly dependent on glucose as a source of vitamin C, additional nutrients are still available and the temperature is maintained at around 30^{0}C. When observed from the graph of time and concentration of ethanol formed, it can be seen that the amount of ethanol graph moves up on day 3, but at day 4 increased levels of ethanol are not as sharp as before, and even tends to decline. This is because the availability of glucose and nutrient fermentation media which began to decrease so that in the longer fermentation time, the nutrients consumed by microbes less and less.

The results of the determination of the physical properties characterization of ethanol is still showing a significant difference. This is because ethanol is obtained from the distillation of ethanol levels are still low and their compounds which are a byproduct of the distillation (Judoamidjojo, 1989). But with the organoleptic test,

showed ethanol in the sample with a sense of cold on the skin sample, volatile samples when interacting with air and has a characteristic odor.

4. CONCLUSIONS

From the result of this research, bioethanol can be produced by waste banana with fermentation method. Long fermentation gives effect to ethanol derived. The optimum ethanol fermentation obtained at 3 days is 3.97%.

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