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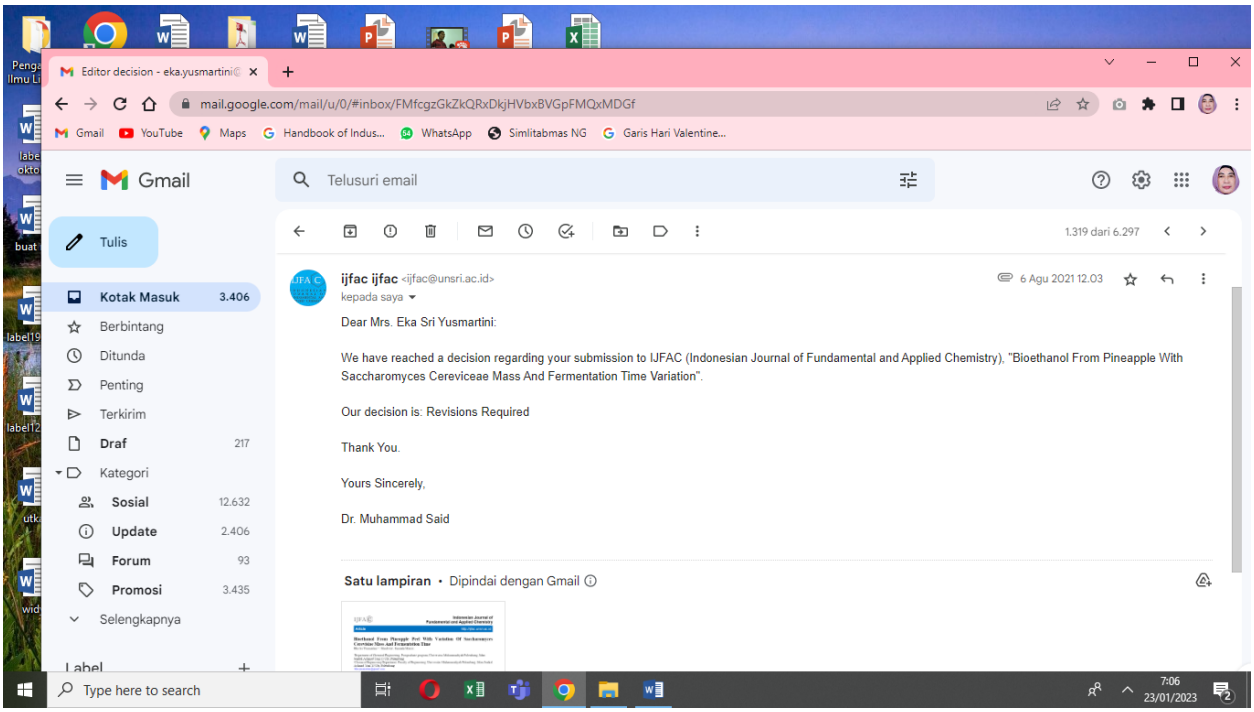

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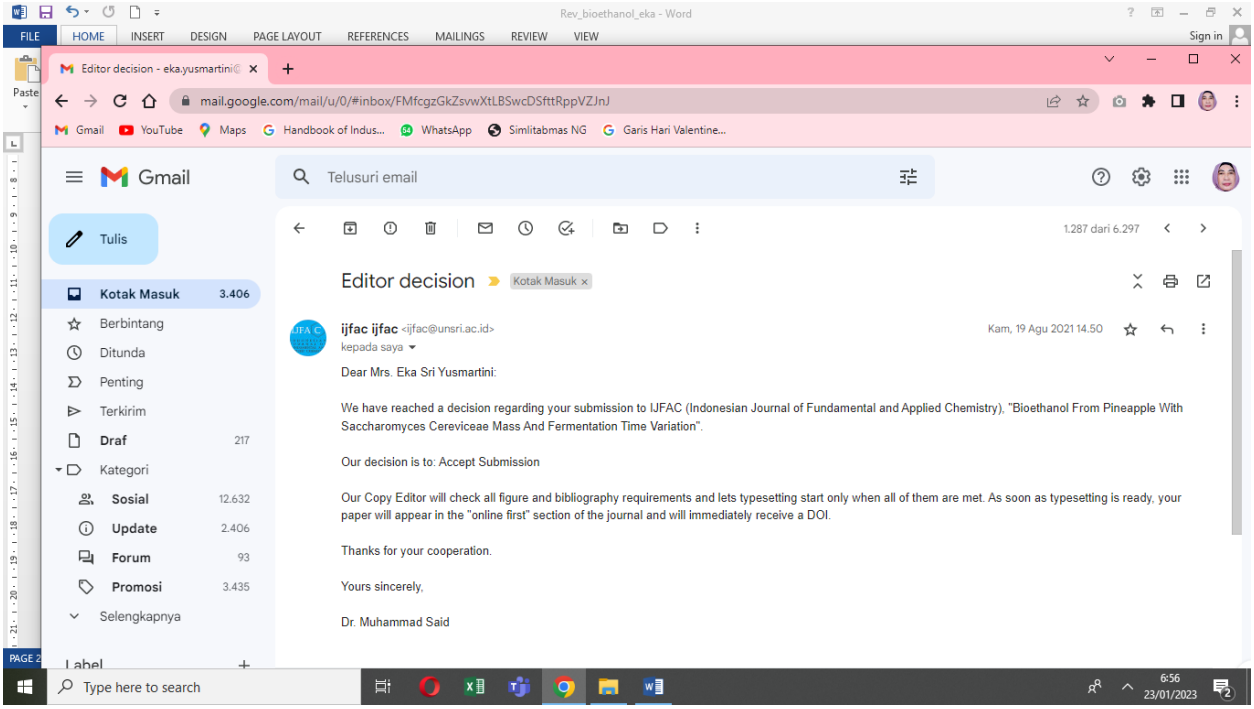

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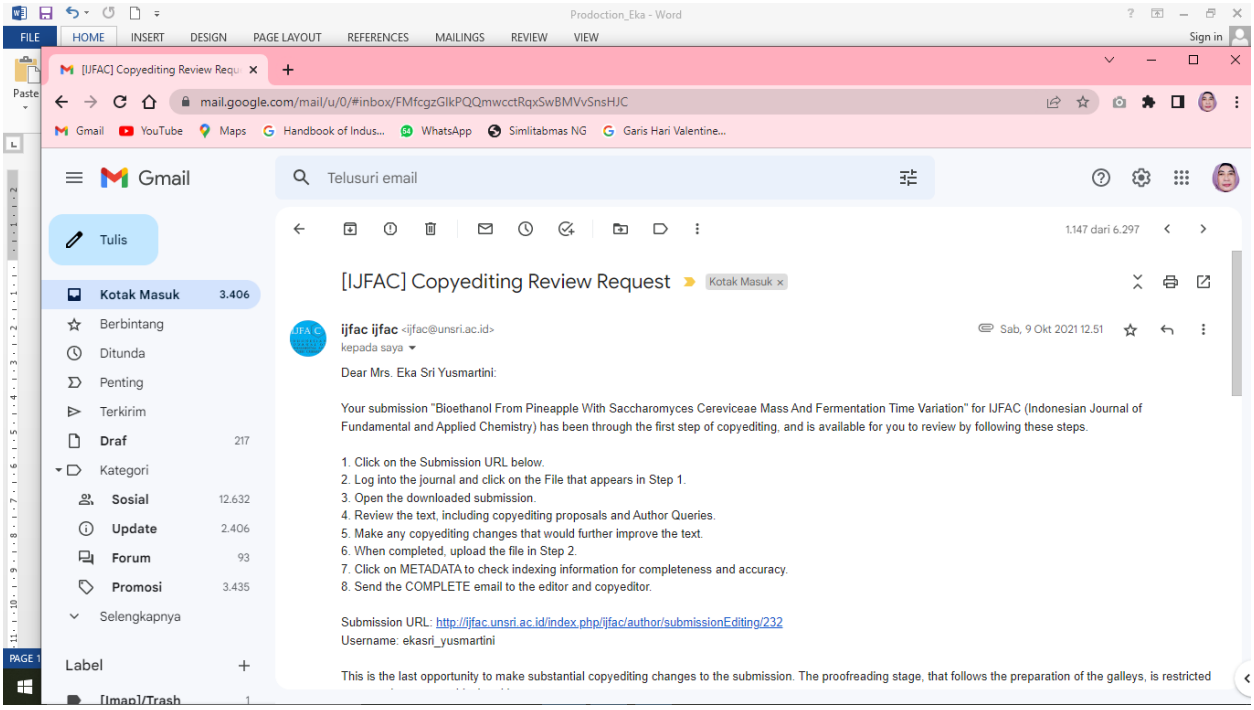

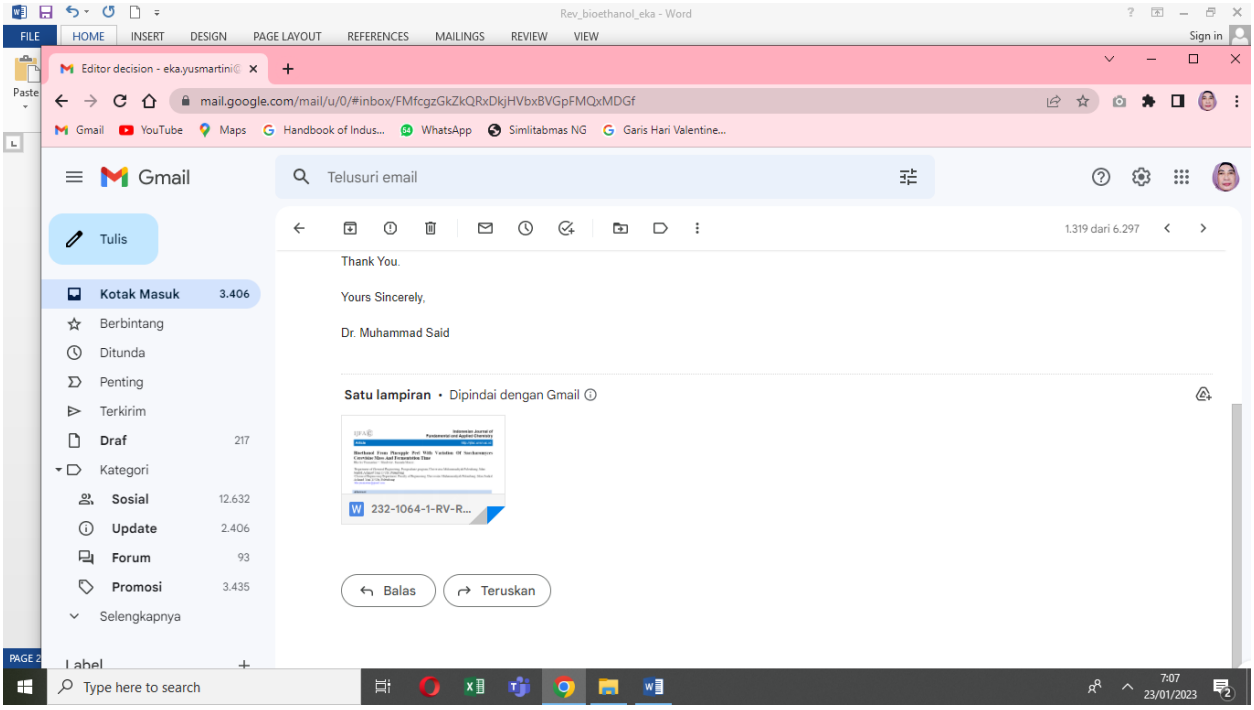
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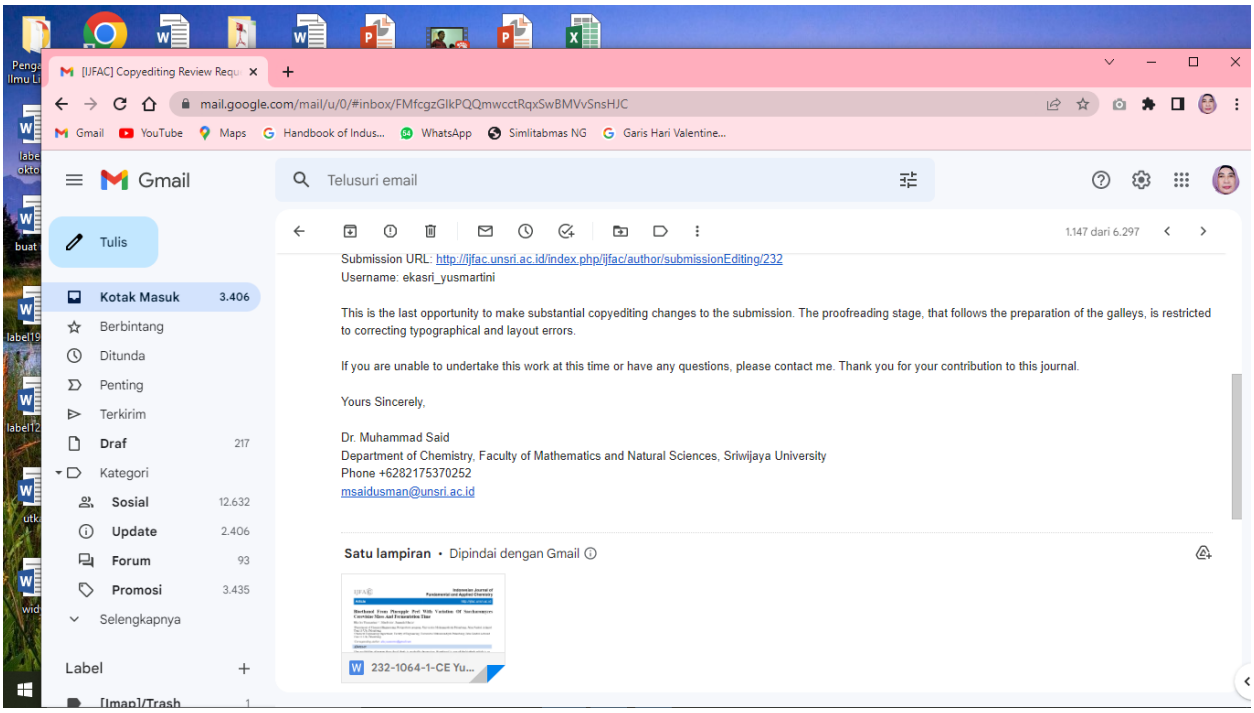
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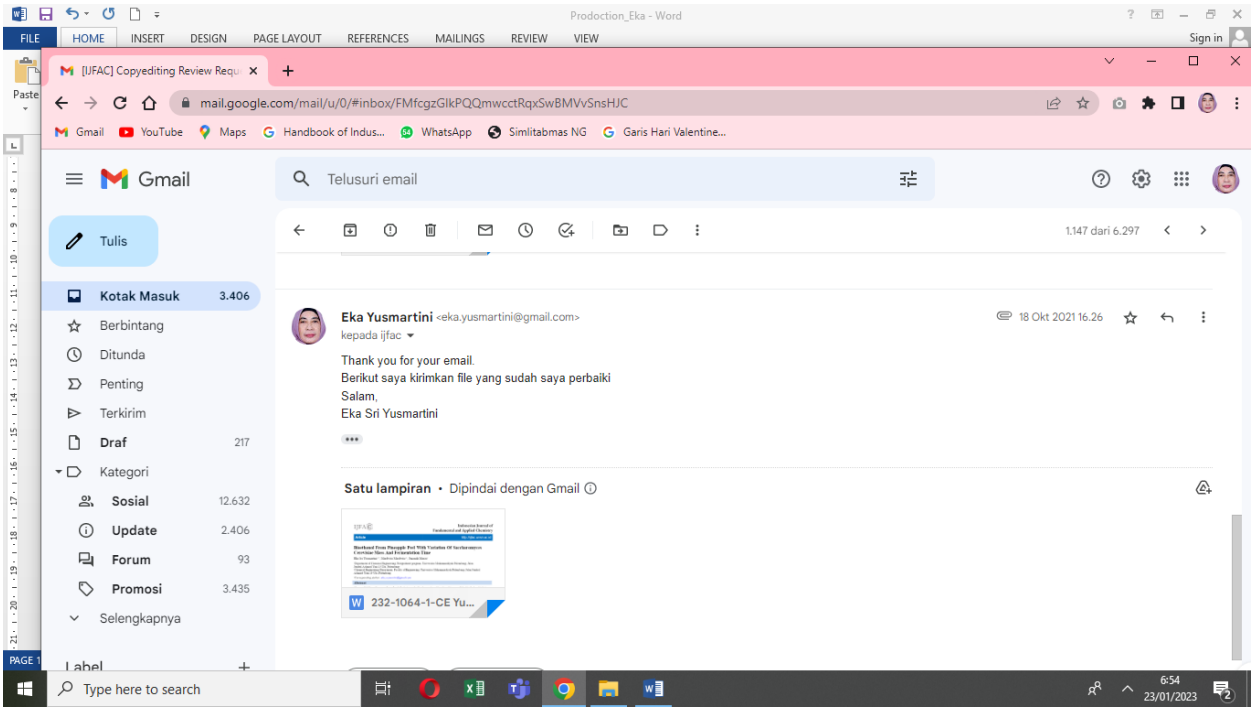
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Bioethanol From Pineapple With Saccharomyces Cereviceae Mass And Fermentation Time Variation

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Abstract

The avaibility of energy from fossil fuel is gradually decreasing. The solution to overcome this problem is to develop an alternative energy source that can be renewed such as bioethanol. Bioethanol is a vegetable based fuel, an alternative energy that can be used as a subtitute for petroleum. One of the raw materials that can be used for the fermentation of bioethanol production is pineapple fruit skin. This research aims to utilize pineapple fruit waste as raw material for making bioetanol by fermentation process, with variations in the addition of saccharomyces cereviceae 20, 25 and 30 g, and time fermentation 5 and 9 days. The highest levels of bioethanol obtained 6,83 % at the addition of 25 g saccaromces cereviceae and fermentation time of 5 days.

Keywords: pineapple skin, saccaromyces cereviceae, fermentation, bioethanol

Abstrak (Indonesian)

Ketersediaan energi dari bahan bakar fosil secara bertahap semakin berkurang. Solusi untuk mengatasi masalah tersebut adalah dengan mengembangkan sumber energi alternatif yang dapat diperbaharui seperti bioetanol. Bioetanol merupakan bahan bakar nabati yang merupakan energi alternatif yang dapat digunakan sebagai pengganti minyak bumi. Salah satu bahan baku yang dapat digunakan untuk fermentasi produksi bioetanol adalah kulit buah nanas. Penelitian ini bertujuan untuk memanfaatkan limbah buah nanas sebagai bahan baku pembuatan bioetanol melalui proses fermentasi, dengan variasi penambahan saccharomyces cereviceae 20, 25 dan 30 g, dan waktu fermentasi 5 dan 9 hari. Kadar bioetanol tertinggi diperoleh 6,83 % pada penambahan 25 g saccaromces cereviceae dan waktu fermentasi 5 hari.

Kata Kunci: kulit nanas, saccharomyces cerevisiae, fermentasi, bioetanol

INTRODUCTION

Today the availability of energy from fossil fuels is increasingly declining. The solution to overcome these problems is to develop alternative energy sources that can be renewed such as bioethanol. Bioethanol is a vegetable-based fuel, an alternative energy that can be used as a substitute for petroleum. One of the raw materials that can be used to make bioethanol fermentation is pineapple fruit skin.[8]

Pineapple is one of the leading fruit commodities in Indonesia. This refers to the amount of pineapple production which occupies the third position after bananas and mangoes. Pineapple production in Indonesia is quite large, based on fixed figures (ATAP) in 2015 Indonesian pineapple production reached 1.73 million tons per [9]. Based on data on average Indonesian pineapple production in 2011-2015, there are 10 provinces which are the centers of national pineapple production. South Sumatra Province is one of the biggest contributors to national pineapple production with 3.35% of total national production and ranks 9th above East Kalimantan.[4]

In 2015 the average pineapple production in South Sumatra province was in the range of 59,433 tons / year [4]. With such a large annual production of pineapple, this has the potential to produce pineapple skin waste

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in large quantities and this can be utilized as a raw material for making bioethanol.[10]

Pineapple (Ananas comosus L. Merr) is a type of fruit found in Indonesia, which has a fairly even distribution. Based on field case studies, several seasonal pineapple businesses in Prabumulih, South Sumatra have an average production capacity of 12-15 kg / day, with the number of pineapple fruits used as raw materials around 200 kg / day. Pineapple skin waste produced from one pineapple fruit ranges from 21.73 to 24.48% [6], so that pineapple waste produced can reach 40-50 kg / day [7]. Based on its nutrient content, pineapple fruit skin contains carbohydrates and sugar which is quite high. Pineapple skin contains 53.1% water, 14.42% crude fiber, 17.53% carbohydrate, 1.3% protein and 13.65% reducing sugar.[14]

In general, ethanol production includes three series of processes, namely raw material preparation, fermentation and purification [1]. In the preparation stage, the raw material must first be converted into a sugar solution which will eventually be fermented into ethanol [11]. In the fermentation stage, the breakdown of simple sugars into ethanol involves enzymes and yeast. While the ethanol purification stage, zeolites are used for the dehydration process using adsorbents.[2]

The adsorption dehydration process is an advanced process of the Distillation process . Where in the distillation process the purity of ethanol obtained 96% and could not increase again, because the azeotropic point of the water-ethanol mixture was 96% [3]. In azeotropic conditions, it is difficult to separate the water-ethanol mixture by the Distillation method [5]. To achieve bioethanol (> 95%) further purification must be carried out by the dehydration process (molecular sieve dehydration) because this process can remove water to ethanol levels to 99.5% and produce absolute ethanol. [13]

Based on the description above, it can be concluded that pineapple skin has the potential to be processed into biodiesel fuel because pineapple skin contains carbohydrates and sugar which is quite high. This allows pineapple skin to be used as raw material for bioethanol. Apart from that, the supporting factor of the potential of a large pineapple-producing region in the province of South Sumatra can also be used as a foundation for the development of Bioethanol production from pineapple skin for the future.

Based on this also, further research will be carried out to process pineapple skin in the form of slurry by using the Liquid State Fermentation (LSF) method to become bioethanol with a variation of fermentation time (5 days, 9 days) and the addition of saccharomyces Cereviceae microbes and the glucosyl amylase enzyme and α-amylase.

MATERIALS AND METHODS

Materials

Based on research conducted pineapple peel is used as raw material, Saccharomyces cereviceae (SC), glucose amylase enzyme, --amylase enzyme. To conduct this research also use equipment, such as beakers, erlemeyer, measuring pipette, analytical balance, distillation apparatus, pycnometer, refractometer, spatula, funnel, blender, electric stove, burette, filter paper, analytical balance.

Methods

Pineapple skin waste obtained from traders at the pineapple market in Pusri, washed and then dried in the sun for + one hour. The dried sample is then blended to form a slurry.

Slurry-shaped samples were then added with 5 mL of alpha-amylase and glucose amylase enzymes. Then the sample is heated at 100 ^{0}C for ± 30 minutes to a constant temperature. The sample is then cooled at room temperature ± 15 minutes to a constant temperature. The fermentation process is carried out by varying the yeast weight of 20, 25 and 30 g. The fermentation time is carried out for 5 and 9 days. Then the distillation process is carried out at a temperature of 78.4 ^{0} C and analyzed the levels of bioethanol obtained.

RESULT AND DISCUSSION

Ethanol Fermentation Result

The results of research on making bioethanol from pineapple skin with the addition of Saccharomyces cereviceae and fermentation time variations can be seen in Table 1 and Table 2 below.

Table 1. Ethanol obtained from fermentation proces with variations in time and yeast

Sample	SC *(g)*	Day-	Amount of raw material *(mL)*	Sample volume *(mL)*
A	20	5	500	150
		9		170
B	25	5		163
		9		175
C	30	5		168

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	9		180

Table 2. Ethanol Distillation Results

Sample	SC *(g)*	Day-	Sample volume *(mL)*	Ethanol (*mL*)
A	20	5	150	37
		9	170	21
B	25	5	163	24
		9	175	45
C	30	5	168	31
		9	180	33

Table 3. Test Results for Density, Index of Refraction, and Ethanol Content

Sample	Treatment	Analysis Results		
		Ethanol (%)	Density (g/mL)	Index of Refraction
Fermentation Product	5 d- 20g	4,50	0,9950	1,3336
	5 d- 25g	6,83	0,9923	1,3350
	5 d- 30g	4,50	0,9958	1,3336
	9 d- 20g	4,67	0,9964	1,3337
	9 d- 25g	3,00	0,9937	1,3327
	9 d- 30g	4,67	0,9947	1,3337

*Test Result : 58/PL6.I.14.1/A/2018

Effect of Fermentation Time and Yeast Weight on Bioethanol yield

The longer the fermentation process, and the more yeast dose Saccaromyces cereviceae is given, the alcohol content will increase [2]. The longer the fermentation time, the number of microbes decreases, and will go to the phase of death because alcohol is produced more and more nutrients that are available as microbial food decreases [6]. Figure 1 shows that the highest level of bioethanol, 45 ml, was obtained during the 9-day fermentation treatment and 25 grams of Saccaromyces cereviceae mass addition. The longer the fermentation process and the more yeast doses given the higher levels of bioethanol. The highest ethanol content at 9 days fermentation due to the activity of yeast Saccaromyces cerevisiae that works optimally and enzymatic activities that are not inhibited [3].

Fermentation time affects the results because the longer the fermentation time will increase the levels of bioethanol. However, if fermentation takes too long the nutrients in the substrate will be exhausted and yeast Saccaromyces cerevisiae can no longer ferment the ingredients. In the treatment of adding 30 g of Saccaromyces cerevisiae, and the fermentation time of 9 days obtained 33 ml of bioethanol levels lower than the addition of 25 g of Saccaromyses cereviae obtained of 45 ml of bioethanol. This is because the amount of available nutrients is not proportional to the amount of Saccaromyces cereviceae which is more, so that Saccharomyces cereviciae lacks food which causes the performance of Saccharomyces cereviciae to decrease and result in the levels of bioethanol produced will also decrease.

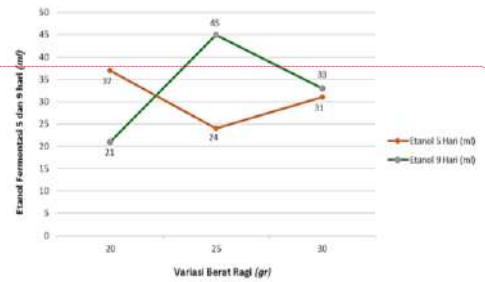

Figure 1. Effect of Fermentation Time and Yeast Weight on Yield of Bioethanol

Effect of Fermentation Time and Yeast Weight on Bioethanol yield

In Figure 2, Effect of fermentation time and yeast weight on density. Bioethanol Density Test is carried out using a pycnometer, where an empty pycnometer is weighed, then the distillate is inserted into the pycnometer then weighed and calculated using the equation below:

$$\rho = m/V_p$$

where :

m = mass of pycnometer filled with samples - empty pycnometer mass

Vp = Volume picnometer

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• Pada berat ragi 20 g, volume etanol yang diperoleh pada fermentasi 5 hari lebih besar daripada 9 hari, dan pada berat ragi 30 g, volume etanol pada masing-masing hari cenderung mendekati. Mengapa bisa demikian?

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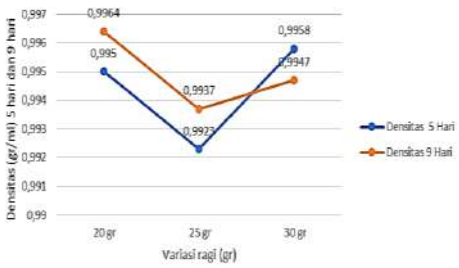

Figure 2 Effect of fermentation time and yeast weight on density

From the data obtained, a graph is made of the effect of fermentation time and yeast weight on the density test. In figure 1 it can be seen that the best variation of yeast and fermentation time in the density test is obtained at a treatment time of 5 days and 25 g yeast weight with a density of 0.9923 g /mL. Density of 0.9923 is still far from the standard bioethanol density which is 0.789 g / mL.[12]

This occurs due to distillation which is done using only simple distillation and also lack of precision in maintaining the stability of the temperature in the distillation process resulting in steam that comes out not only bioethanol but mixed with water and other impurities. However, from the graph it can be concluded that the differences in fermentation time variations and yeast weight variations affect the size of the density obtained.

Effect of Fermentation Time and Yeast Weight on Bias Index

In Figure 3, we can see the relationship between fermentation time and yeast weight to the refractive index. Refractive index is seen using a refractometer, where pure ethanol is analyzed in a refractometer to obtain an ethanol refractive index, then ethanol is dissolved at concentrations of 2%, 4%, 6%, 8% and 10% (possible levels of bioethanol produced by the fermentation process) and analyzed in a refractometer. Then the sample is analyzed with a refractometer and the results are recorded and an equation is made. From the analysis carried out obtained the equation:

$$y = 0{,}0006x + 1{,}3309$$

where :

y = sample refractive indexs
x = ethanol percentage (%)

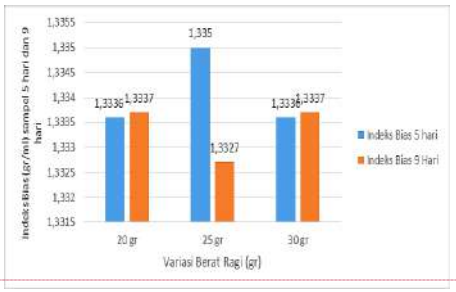

Figure 3 Effect of fermentation time and yeast weight on index of refraction

The best refractive index is at 5 days fermentation time and the addition of yeast 25 gr with refractive index 1.3350, this refractive index is the closest index to 1.361 [12]. The best refractive index follows the best density, which is at the time of fermentation for 5 days and the addition of 25 gr yeast has a density of 0.9923 gr / ml and an ethanol content of 6.83%. So the higher the ethanol content, the refractive index produced is also higher.

Effect of fermentation time and yeast weight on ethanol percentage

In Figure 4, we can see the effect of fermentation time and yeast weight on bioethanol levels. Bioethanol levels here are calculated based on the above refractive index equation. The best levels of bioethanol were obtained at 5 days of fermentation and yeast weight of 25 grams in which bioethanol levels were 6.83% and strengthened with a lower density that is close to the bioethanol density, and the refractive index that is closest to the bioethanol refractive index. So it can be concluded that the best bioethanol content is at the time of fermentation for 5 days and yeast weight of 25 grams.

In contrast to the Distillation Results that have been done show that the highest levels of bioethanol which is 45 ml was obtained at the time of fermentation treatment for 9 days and the addition of mass Saccaromyces cereviceae as much as 25 grams. After conducting the density test and refractive index percent ethanol content in the treatment of the sample, it has

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the lowest ethanol content percent which is 3.00% compared to the other 5 samples

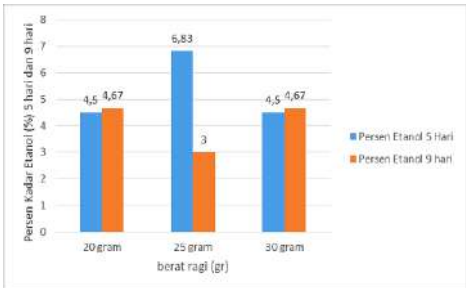

Figure 3 Effect of Fermentation Time and Yeast Weight on Ethanol Percentage

This is due to the distillation process carried out less than the maximum. When controlling the temperature of the solution in the distillation flask if it is not done properly, the volatile bioethanol will easily evaporate so that a lot of bioethanol is lost during the distillation process and there is a mixture of water and impurities that come together in the distillate.

CONCLUSION

From the results of research and discussion it can be concluded that pineapple skin contains carbohydrates and sugars which are quite high, so that the potential for bioethanol can be increased. The addition of Saccharomyces Cereviceae yeast and fermentation time affect the quality of bioethanol produced from pineapple fruit skin. Based on the analysis results, the optimum ethanol content was obtained by adding 25 g of Saccharomyces Cereviceae and 5 days fermentation time, which was 6.83%. This is supported by a density value of 0.9923 g / mL and a refractive index of 1.3350.

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•Hapus garis horizontal pada background grafik
•Judul sumbu-y tidak perlu disebutkan 5 dan 9 hari
•Harap konsisten untuk menggunakan jenis visualisasi data apakah menggunakan histogram atau line
•Mungkin maksud penulis adalah figure 4

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