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Research paper

Bioetanol production optimization from pineapple leather filtrates

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Abstract

Pineapple skin is an agricultural waste that has a high sugar content, ranging from 8.7% to 17.53%. The high sugar content in the pineapple skin allows it to be used as raw material for bioethanol production through fermentation. The process of making bioethanol is through several stages. The extraction process is carried out by destroying pineapple skin which has been added to aquadest with a weight ratio of pineapple skin: aquadest = 1: 1 then a screening process is carried out. The resulting pineapple skin juice is then analyzed for its glucos content. The fermentation process takes place anaerobically at pH 4-5 using yeast (Saccharomyces cerevisiae) as a microorganism that will break down glucose into ethanol. In order for optimal yeast growth and breeding, 4 grams of urea is added as nutrients into the media. To separate the ethanol that is formed, the distillation process is carried out at a temperature of 85-900C for approximately 3 hours until the distillate does not drip again. In this study, variations in yeast weight ratio were used and the length of fermentation time. From the results of the study, weighing 500 grams of pineapple skin produced ethanol with optimal levels of 30.15% (b / b), yield 16.07%, glucose conversion of 31.25% with fermentation time for 2 days.

Keywords: *Ethanol; Yeast; Optimal; Distillation; Glucose Conversion; Nutrient; Saccharomyces Cerevisiae.*

1. Introduction

Ethanol is a biofuel, and has good prospects as a substitute for liquid and gasohol fuels with renewable, environmentally friendly and highly micro-economical raw materials for rural communities, especially farmers. Pineapple fruit (Ananas comosus L. Merr) is one type of fruit that is widely available in Indonesia and has an even distribution. Besides being consumed as fresh fruit, pineapple is also widely used as a raw material for the beverage and food industry. From the consumption of pineapple fruit, there will be quite a lot of skin as a waste, and the potential to be used as raw material for bioethanol production. This study aims to: a) Determine the ratio between yeast and skin filtrate to the quality of ethanol produced. b) Determine the optimum conditions of fermentation from the pineapple skin filtrate to the bioethanol.

1.1. Pineapple

Pineapple is a plant that is widely cultivated in tropical and subtropical regions. Pineapple fruit (Ananas comosus L. Merr) is one type of fruit found in Indonesia, has an even distribution. In addition to being consumed as fresh fruit, pineapple can also be processed as food and drinks such as jams, sweets, wine and others. From these preparations, pineapple fruit skins are obtained quite a lot as a result of waste or waste [1].
Pineapple fruit honey plant is one of the queen pineapple fruit plants. Pineapple fruit honey has characteristics including spiny leaves, golden yellow flesh, generally planted on low land [2]. The size of honey pineapple fruit is smaller than the cayenne type, which is 0.5-1.1 kg. Pineapple honey can be seen in Figure 1.



Fig. 1: Pineapple Honey.

1.2. Saccharomyces cereviseae

Saccharomyces cereviseae is one of the microorganisms included in the yeast group which is distinguished from mold because it is unicellular. Saccharomyces cereviseae has the characteristics of cylindrical cells with a cell size of 5-20 microns larger than bacteria, reproducing vegetatively, especially by budding, cell walls that are stronger than bacteria, can live in aerobic and anaerobic conditions, do not photosynthesis and faster growth compared to algae or algae [3].

1.3. Bioetanol

Bioethanol is a biochemical liquid from the fermentation process of sugar and carbohydrates by using the help of microorganisms [3], [11].

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$C_6H_{12}O$ Khamir Saccharomycescereviseae $C_2H_5OH + 2CO_2$

Glucose Etanol + Karbondioksida

Based on the level of ethanol it can be divided into three groups, namely:

1) Technical ethanol

Technical ethanol is ethanol with a content of 92-94% (v / v) and having fusel oil content between 15-30 mg / L is usually used in producing drugs, organic solvents and spritus raw materials. Fusel oil is a mixture of high levels of alcoholic compounds.

2) Prima Ethanol

Prime ethanol is high quality ethanol with levels of 96-96.5% (v / v), also called pure ethanol with very low fusel oil content (40mg / L). Ethanol is usually used for high quality liquor, pharmaceutical industry and cosmetics industry.

3) Absolute Ethanol

Absolute ethanol is ethanol with very high levels of 99.5% (v / v) and is used in the industry for fuel [4], [10].

1.4. Fermentation

Fermentation is the process of breaking down glucose into alcohol and removing CO_2 with the help of microorganisms. The fermentation process does not use oxygen or known as anaerobic fermentation. Alcoholic fermentation of glucose can generally be carried out by microorganisms such as yeast, fungi and bacteria [5], [10].
The process of making bioethanol can come from vegetable ingredients that contain carbohydrates, glucose and can be fermented directly into ethanol, but disaccharides, starch or complex carbohydrates must be hydrolyzed first into a simple component, namely monosaccharides. Carbohydrates and glucose contained in pineapple skin can be converted into alcohol through a fermentation process.

1.5. Distillation

Distillation is a heating process that separates ethanol with several other liquid components from the fermentation substrate to obtain higher ethanol levels [6]. The basic principle of distillation is a separation technique based on differences in boiling points or melting points of each constituent of a homogeneous mixture.

1.6. Pasteurization

The pasteurization process is a heating process with a relatively low temperature (below 100°C) with the aim of killing all pathogenic microbes (causes of illness) [7].

1.7. Lane eynon method

Determination of sugar by Lane Eynon method is by titrating the Soxhlet (Fehling A and Fehling B) reagent with the sugar solution investigated. The amount of sample solution needed to titrate the Soxhlet reagent can be seen by the amount of sugar available by looking at the Lane Eynon table. In order to obtain the right determination, the Soxhlet reagent needs to be standardized with a standard sugar solution. This standardization is done to determine the magnitude of the correction factor in using Lane Eynon tables. Titration of the Soxhlet reagent with a sugar solution will end if the color of the solution changes from blue to colorless. The indicators used in this method are methylene blue [8].
Lane Eynon titration is used to calculate reduced sugar levels. through this method can be known the remaining reducing sugar contained in the solution, so it can be calculated how many conversions obtained. This titration uses the methylene blue indicator. The color changes that occur are from blue until all the blue color changes to redness which indicates the presence of copper oxide deposits. Color can return to blue because it is oxidized by air. Oxidation reactions can be prevented by titration by boiling the titrated solution so that vapor can prevent contact with air and prevent oxidation again [9].

2. Research methodology

2.1. Pineapple skin extraction

Wash pineapple skin clean. Prepare a comparison size of pineapple and aquadest skin with a ratio of pineapple skin: aquadest = 1: 1, then extracted using an extractor for one hour. Separating filtrate from pineapple peel until no pulp is carried in the filtrate.

2.2. Analysis of glucose levels with the lane-eynon method

2.2.1. Standardization of fehling solutions

Arrange the titration tool. Dissolve 1.25 grams of standard glucose with 500 ml of distilled water in a 500 ml measuring flask. Insert the solution into a 50 ml burette. Take 5 ml of Fehling A and 5 ml of Fehling B, and add 15 ml of standard glucose solution to erlenmeyer. Heat the solution on erlenmeyer until it boils and keep boiling for 2 minutes. Adding 1 ml of Methylen Blue indicator then titrating with a standard glucose solution to form a brick red precipitate. Record the volume of standard glucose solution needed for titration. Repeat the experiment 3 times.

2.2.2. Determination of reducing sugars in the sample

Take 10 ml of sample solution then dilute it with distilled water in a 250 ml measuring flask. Fill the burette with a sample solution. Take 5 ml of Fehling A and 5 ml of Fehling B, and add 15 ml of sample solution to erlenmeyer. Heat the solution on erlenmeyer until it boils and keep boiling for 2 minutes. Adding 1 ml of Methylen Blue indicator then titrating with a sample solution to form a brick red precipitate. Record the volume of sample solution needed for titration. Repeat the experiment 3 times and calculate the average volume of the titration.

2.3. Fermentation

2.3.1. Pasteurization

Heating the pineapple peel solution at 700C for 15 minutes. Cool the solution to room temperature (300C).

2.3.2. Manufacture of starter

Take 10% of the volume of the pineapple skin medium and put it in erlenmeyer. Check the pH of the starter solution, if the pH of the solution has not ranged between 4-5 then add HCl or NaOH so that the pH of the solution is 4-5. Add yeast and urea to the starter.

2.3.3. Fermentation process

Take the medium solution (the rest of the starter making). Check the pH of the medium solution, if the pH of the solution has not ranged from 4-5 then add HCl or NaOH so that the pH of the solution is 4-5. Mix the medium solution with the starter into the fermentor. Close the fermenter tightly and then connect the fermenter lid with a plastic hose that is inserted into the water.

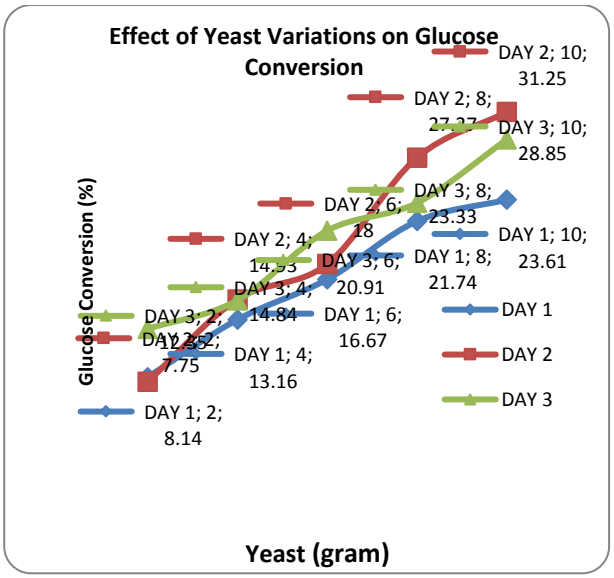
2.4. Distillation

Arranging a distillation device. Insert the fermented solution into a three-neck flask and turn on the heater. Heating the fermented solution at a temperature of 85-900C for about 3 hours until the distillate doesn't drip again. The distillation process is stopped when the distillate does not drip again. Measure the volume of distillate produced.

3. Results and discussion

3.1. Glucose conversion

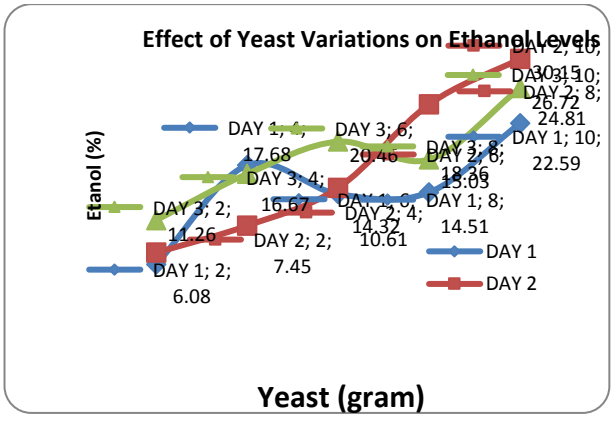
The substrate prepared before the fermentation process was measured by glucos content using the lane eynon method. The measurement results showed that the glucose level in pineapple skin extract was 19.74%. This glucose is then continued with the fermentation process to produce bioethanol.



Graph 3.1: Effect of Yeast Variations on Glucose Conversion.

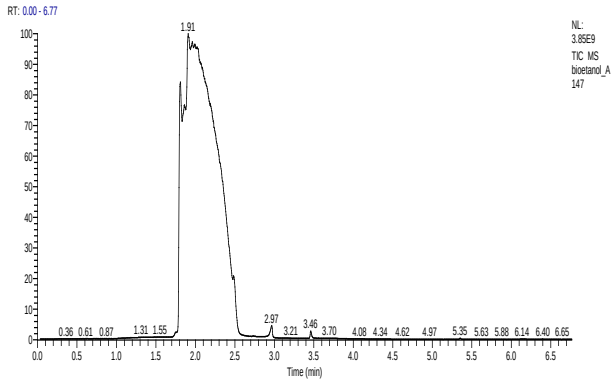
3.2. Bioethanol levels

The longer the fermentation process and the more yeast doses given, the higher the bioethanol level. The highest ethanol content during fermentation was 2 days due to the optimal activity of Saccaromyces cerevisiae yeast and enzymatic activities that were not inhibited. In the addition of 10 grams of Saccaromyces cerevisiae, and 3 days of fermentation, bioethanol was 26.72% lower than addition of 10 grams at the time of fermentation the second day of Saccaromyces cerevisiae obtained 30.15% bioethanol content.



Graph 3.2: Effect of Yeast Variations on Ethanol Levels.

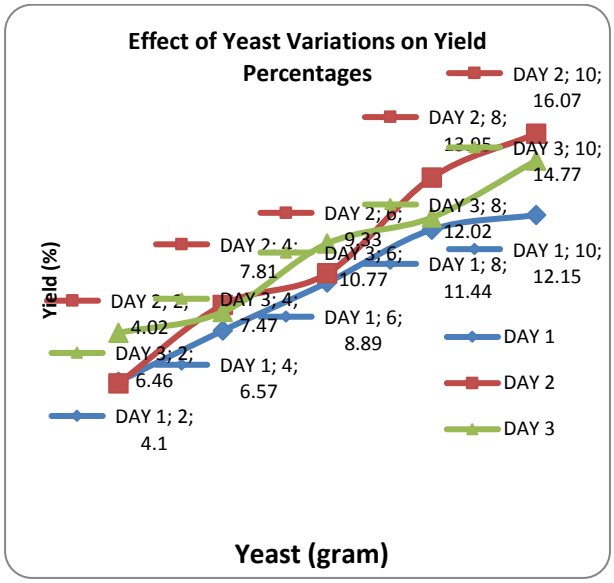
While for ethanol content analysis using GC. Graph 3.3 is obtained using gas chromatography



Graph 3.3: Ethanol Level using Gas Chromatography.

3.4. Percent yield

To obtain data on the effect of yeast on etano yield in this study was carried out by fermenting 500 grams of pineapple skin filtrate, sugar content of 19.74% solution, fermentation time for 3 days, pH of solution 4 with room temperature of 300C (fixed parameters), while yeast concentration of 2-10 grams. From graph 3.4 it can be seen that the optimum length of fermentation was reached on the second day with yiel ethanol at 16.07%.



Graph 3.4: Effect of Yeast Variations on Yield Percentages.

4. Conclusion

Based on the results of the research that has been done, the following conclusions can be obtained:
Yeast weight variations on pineapple skin fermentation were carried out to determine the optimum bioethanol content, which was 31.25%, glucose conversion with ethanol content of 30.15%. Variations in glucose levels and concentrations of Saccharomyces cerevisiae yeast needed to produce optimum bioethanol levels were 19.74% glucose levels and 10 grams with fermentation duration for 2 days. Basically the longer the fermentation process, the ethanol produced will increase, but at one time the optimum state will be reached where the addition of the next fermentation time will not produce ethanol. In this variable the highest ethanol yield is 16.07%.

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