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The Effect of Addition NPK on Pineapple Peel Fermentation to Produce Bioethanol as a Premium Extender

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ABSTRACT

The depletion of fossil fuels requires alternative energy, one of which alternative energy is bioethanol. Pineapple peel waste has the potential to produce bioethanol because it contains 17.53% carbohydrates and 13.65% sugar which is quite high. The purpose of this study was to produce bioethanol from pineapple peels with the addition of NPK fertilizer as nutrition. The method used is to conduct experiments with the stages: extraction, saccharification, fermentation, distillation, analysis and conclusions. The results obtained were that the highest bioethanol content was obtained in the addition of 20 grams of NPK fertilizer, namely 29.60%.

Keywords: Bioethanol, NPK Fertilizer, Pineapple Peel

INTRODUCTION

The present energy system is heavily depending on the use of fossil fuels. Facing the challenge of depletion fossil fuels reserves and rising world oil price, many countries has undertaken the initiative to promote the development and dissemination of renewable energy [1]. The fuel need is still dominated by petroleum refined products. Petroleum is still the main driver of the world economy, because industrial equipment and transportation for the distribution of basic needs still uses refined fuels from petroleum. The petroleum is created by millions of years from fossil and cannot be renewed but the fuel consumption is increasing day by day. It is estimated that oil reserves in Indonesia will only be sufficient to meet consumption needs for the next 18 years. Meanwhile, gas reserves are sufficient for 60 years and coal for about 150 years. Indonesia's oil wells are now drying up due to continuous drilling without being accompanied by exploration or searching for new sources. In 1970s, Indonesia's crude oil production capacity was still in the range of 1.3 million barrels per day (bpd), in 1998 crude oil production rose to 1.5 million bpd, and now Indonesia only able to produce crude oil of 1,070 million bpd or equivalent to production 33 years ago (1972), namely at the time of the industry national oil started to crawl 1.080 million bpd [2].

The use of premium fuel can cause the various gasses of emission which are dangerous pollutants in the world. Meanwhile, bioethanol does not emit harmful exhaust gasses because bioethanol is one of the organic synthetic chemicals produced by humans. Bioethanol as a fuel mixture has good prospects because of the increasing world crude oil price so it can be used as an alternative fuel [3]. Bioethanol is an appealing energy source as it is clean and produced from renewable sources. It is produced through fermentation by microorganism by one of two methods, distinguished by the raw materials [4][5]. Bioethanol is ethanol produced from living things so that it exists can be created. The raw material for making ethanol comes from various plants, both those directly produce simple sugars such as sugar cane, sweet wheat or yang produce starches such as corn, cassava and wheat. In general the ingredients that contain starch is converted into sugar through a process of breaking down into complex sugars (liquidation) and breakdown of complex sugars into simple sugars (saccharification) with the addition of water and enzymes [6]. The conversion of glucose to bioethanol requires a microbial intermediary such as Saccharomyces cerevisiae. The fermentation process will be carried out by Saccharomyces cereviseae because it is able to change fluids which contains sugar into alcohol and CO_2 gas quickly and efficient [7].

In Subang regency, West Java, one of the main commodities produced by farmers is

pineapple. There are many home industries that process pineapple fruit into various kinds of foods. In addition to producing processed pineapple fruit, the home industries also produces waste from pineapple fruit processing, one of which is pineapple peel. Pineapple peel waste has not been widely used. Pineapple peel contains 81.72% water, 20.87% crude fiber, 17.53% carbohydrates, 4.41% protein and 13.65% sugar reduction, and therefore pineapple peel has the potential to be used as raw material for manufacturing bioethanol [8]. This research aims to produce bioethanol from pineapple peel fermentation in addition fertilizer of Nitrogen Phosphorus and Potassium (NPK) or urea. Raw materials used for making fermentation bioethanol can be obtained from plants that produce sugar and flour. At the preparation stage, the raw material must be flour first converted into sugar, while the raw materials are in the form of a sugar solution can be directly fermented [2]. The fermentation process also need yeast and in order for growth and for optimal yeast breeding, 4 grams of NPK is added as nutrients into media [1]. In Figure 1 shows a garden pineapple that is located in Subang regency.

RESEARCH METHOD

The research using experimental method and was conducted July to September 2019 at the Subang State Polytechnic Laboratory. The step of the research began with collecting data by observation and study of literature about bioethanol, compile research design, experiment of bioethanol in laboratory, and analyze the result of experiment and making the report. The step of the research can be looked in the flow chart at the following Figure 2.

The stages of making bioethanol from pineapple peel are extraction process from pineapple peel in order to get the filtrate. The saccharification process need to breakdown the complex sugar in to simple sugar. The next process is the fermentation process, the microorganisms used are Saccharomyces cerevisiae, is a yeast that is commonly used to produce alcohol by fermentation [9]. The fermentation process influenced by pH (acidity level), temperature, nutrition (NPK/urea), carbon source, and fermentation time [10].

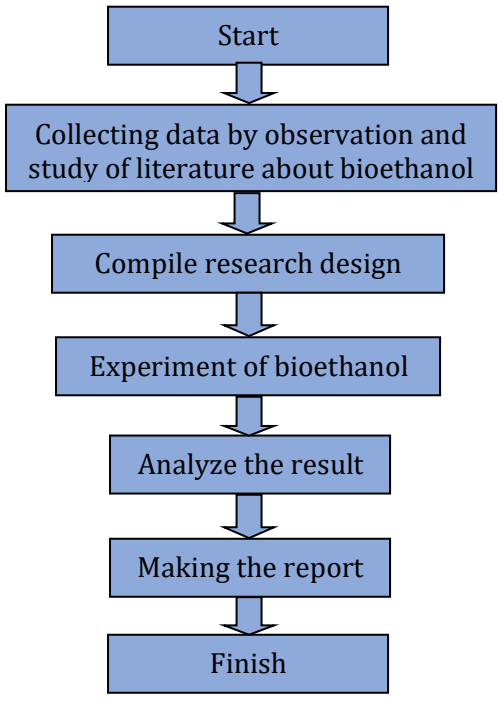

Figure 1. Flow chart the stage of research

After that to get ethanol content, a distillation process is carried out [11]. The next stage is analysis to measure density, pH and yield to get conclusion. The steps for making bioethanol can be seen in Figure 3 below:

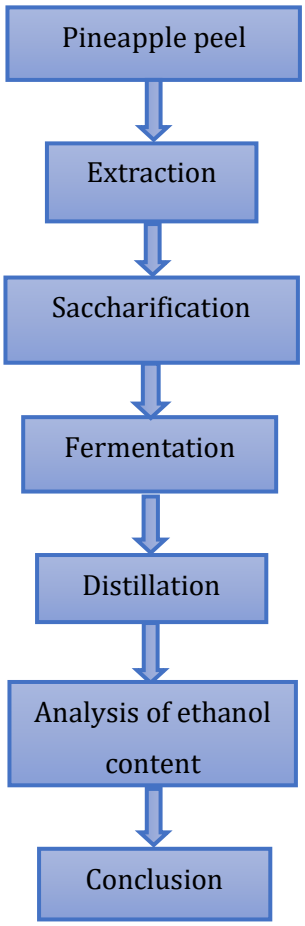

Figure 2. The stages of making bioethanol from pineapple peel

The tools that used for making bioethanol are: digital scale, knife, timer, blender, container, measuring cylinder, thermometer, Erlenmeyer flask, volumetric pipette, electric stove, thermo control, reverse cooler, a set of vacuum distillers, alcohol analyzer, separating funnel, volumetric flask, beaker glass, watch glass, dropper, stirrer, filter paper. Materials used in this research are pineapple peel, yeast, Methylene blue indicator, pH meter, Fehling A, Fehling B, aqueduct, urea (NPK).

The process of making bioethanol is as follows:

a) Use work safety tools.
b) Prepare tools and materials.
c) Extract the pineapple peel with the following step: (1) clean the pineapple peel; (2) blending the pineapple peel as much as 500 grams and mixed with 1000 ml of water; (3) Separating the filtrate from the pineapple peel pulp until there is no pulp carried away in the filtrate.
d) Saccharification process with the steps: (1) slurry cooling to the optimum temperature of the saccharification enzyme; (2) setting the optimum pH of the enzyme; (3) adding the enzyme (glucoamylase) appropriately; (4) maintaining pH and temperature in the range of 50°-60°C until the saccharification process is complete (done by testing the sugar simple generated).
e) In the fermentation process 14 grams of tape yeast are added and 5, 10, 15, 20, 25 grams of NPK fertilizer that has been mashed on each container. The fermentation process is carried out in an Anaerobic (without air), the temperature must be maintained around 28-30°C (allowed to stand at room temperature). After the fermentation process is complete, the container can be opened

and a pungent odor is obtained, then filtered and squeezed, then the resulting liquid is collected in another container.

f) In the distillation stage, namely separating the water content and bioethanol. For the first process, prepare an electric stove with 300 watts of power, then a thermo control that is useful for adjusting the temperature during the heating process so that the resulting temperature can be maximized and evenly hot. Then prepare a glass flask with a capacity of 1 liter. As well as the Liebig condenser which is useful as a coolant in the evaporation process, it is recommended that in the cooling process the water used is at a constant temperature of 25-27^{o}C so that the process of cooling the steam into the liquid phase can run optimally, and enough bioethanol is produced. In the distillation process, you should use a temperature of around 78-80^{o}C. From the first distillation, bioethanol is obtained, then the alcohol content is measured using an alcohol meter. The NPK fertilizer composition which has the highest alcohol content is then distilled on a larger scale for the second distillation process by adding silica gel and salt. If the alcohol content has not reached the desired level, which is more than 90%, then carry out the third distillation process. The third distillation process is the same as the second distillation, after doing the third distillation measure the bioethanol yield obtained again. The maximum yield obtained from this simple distillation process is only up to 95% levels.

RESULTS AND DISCUSSIONS

The research has been carried out by producing data on the levels of bioethanol contained in the fermented pineapple peel.

Figure 3. Pineapple garden in Subang regency

The research was conducted to find the parameters of the weight of NPK fertilizer on bioethanol content give variations in the weight of NPK fertilizer, namely 5 grams, 10 grams, 154 grams, 20 grams, and 25 grams. The weight of pineapple peel is 500 grams, the amount of water is 1000 grams, the weight of yeast is 14 grams and the fermentation time is 4 days. This research was conducted 5 times each of the addition of NPK fertilizer nutrients that were added during fermentation to obtain the highest average bioethanol content. The results of the research are as follows:

Table 1. The result of experiment

Fermentation Time (Day)	Comparison Raw Material and Water (1:2) gr	The Amount of NPK Fertilizer (gr)	The Amount of Bioethanol (ml)	Bioethanol Content (%)	Bioethanol Content Average
4	500 1000	5	50	19	
4	500 1000	5	52	20	
4	500 1000	5	55	22	20
4	500 1000	5	54	19	
4	500 1000	5	50	20	
4	500 1000	10	60	23	
4	500 1000	10	63	22	
4	500 1000	10	65	23	22.8
4	500 1000	10	62	23	
4	500 1000	10	65	23	
4	500 1000	15	45	25	
4	500 1000	15	44	24	25
4	500 1000	15	45	26	
4	500 1000	15	44	25	
4	500 1000	15	40	25	
4	500 1000	20	50	28	
4	500 1000	20	54	31	
4	500 1000	20	55	30	29.6
4	500 1000	20	53	29	
4	500 1000	20	55	30	
4	500 1000	25	40	20	
4	500 1000	25	42	21	
4	500 1000	25	40	20	20.8
4	500 1000	25	44	21	
4	500 1000	25	45	22	

Based on the table above, it can be seen that the amount of 20 grams of NPK fertilizer contains the most optimal average bioethanol content of 29.60%, while the amount of 5 grams of fertilizer contains the lowest average bioethanol content of 20.00%. This happens because the nutrients provided by NPK fertilizer during the fermentation process are not in accordance with the needs. The amount of 25 grams of NPK fertilizer contains bioethanol levels on average of 20.80%, there is a decrease, and this is because the nutrients given during the fermentation process are excessive so the fermentation process is not optimal. The several steps for making bioethanol can be seen in the following Figure:

Figure 4. The pineapple peel

Pineapple Peel is washed to clean from dirt. Then ready to be weighed, then crushed.

Figure 5. 500 gram of pineapple peel

Weigh the peel pineapple according to the desired dose. Factors that can affect the amount of bioethanol produced from fermentation is the [12] with microorganism as a medium. The longer the fermentation time, the lower the number of microbes, and will go to the death phase because more alcohol is produced and the nutrients available as microbial food decrease.

Figure 6. The pineapple pulp

Peel pineapple that has been crushed, then measured according to the desired size. The relation between the addition of NPK nutrient mass to ethanol concentration is that the higher addition of NPK (up to 2%), so that the higher the ethanol produced, because the bacteria Saccharomyces cerevisiae requires nutrients like nitrogen and phosphorus for the growth [13][14]. Production of bioethanol from pineapple wastes, especially the fruit peels, became possible. In this study, the effects of alkaline pretreatment and microbial hydrolysis through Trichoderma harzianum of pineapple fruit peel were evaluated [15]. The results show that the main sugars obtained from pineapple waste were: glucose, uronic acid, xylose, galactose, arabinose and mannose. The highest ethanol yield was achieved after 30 hours of simultaneous saccharification and fermentation, and reached up to 3.9% (v/v), corresponding to the 96% of the theoretical yield [16]. However, when the addition of NPK fertilizer is excess (3%) makes the resulting ethanol concentration decrease, because it can make the pH of the fermentation medium more acidic. The tendency of the fermentation medium to become increasingly acidic makes the Saccharomyces cerevisiae cells denatured by the presence of clots [17].

CONCLUSION

The potency of pineapple fruit can be increased to become bioethanol. The addition of NPK fertilizer/urea has an effect against bioethanol produced from the pineapple peel. The highest bioethanol content was obtained at addition of 20 grams of NPK/urea fertilizer, namely 29.60%.

The result need more experiment to test about the effect of addition NPK, time of fermentation, and type of pineapple to improve the research.

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