The Effect Of Chloride Acid (HCl) Concentration And Fermentation On Bioethanol Levels From Breadfruit (*Artocarpus Artilis*) Substrate

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Abstract. At present, the public demand for fuel oil (BBM) is increasing inversely proportional to its availability. One of the efforts to reduce people's dependence on BBM is to utilize alternative vegetable-based energy such as bioethanol. Bioethanol is a fermented product that can be made from a substrate containing carbohydrates. Breadfruit (*Artocarpus artilis*) is one of the agricultural products that have a fairly high starch content of 89% and is not included as a staple food source in Indonesia. Utilization of breadfruit is still not optimal because breadfruit is only used as a snack or made into flour. This study aimed to make bioethanol with breadfruit raw material (*Artocarpus artilis*). The method of this study consisted of two stages, the first step was the hydrolysis of breadfruit flour with hydrochloric acid (HCL) catalyst. The concentrations of HCL used in this study were 1%, 1.5%, and 2%. The second stage of fermentation using *Saccharomyces cerevisiae* was with 72 hours fermentation time, 120 hours and 168 hours. From the results of the research, it was found that the highest levels of bioethanol to the treatment of HCL 2% concentration and fermentation duration of 168 hours was 17.6%.

Keywords: bioethanol, breadfruit, HCL concentration

1. Introduction
Indonesia is still very dependent on fossil-based fuels as an energy source. Petroleum is a non-renewable energy source. Nevertheless, it is important to realize that the amount of petroleum reserves is decreasing every period. The government of Indonesia responded to the scarcity of petroleum energy in the future by issuing Presidential Regulation No. 5 of 2006 concerning energy policy. Chapter II Article 2 of PP No.5 of 2006 states that the fulfillment of energy consumption in Indonesia is targeted to come from biofuels, which amounts to 5% of total energy consumption. Biofuel is a renewable energy development based on vegetable or often called Biofuel (BBN). One example of biofuel based fuel is bioethanol.

Bioethanol (bioethanol) is ethanol (ethyl alcohol) whose production process uses natural raw materials and biological processes, in contrast to synthetic ethanol obtained from chemical synthesis of hydrocarbon compounds. The characteristics of bioethanol include flammable, soluble in water, biodegradable, not carcinogenic, and if there is pollution it does not have a significant environmental impact (Kusnadi, 2009). Ethanol is an organic compound of the primary alcohol group. The physical
and chemical properties of ethanol depend on the hydroxyl group (Rizani in Rahmawati, 2010). The physical properties of ethanol can be seen in Table 2.1. the following:

| Property                      | Value          |
|-------------------------------|----------------|
| Mr                            | 46.07 g/mol    |
| Freezing point                | -114.10°C      |
| Normal boiling point          | 78.32°C        |
| Denture at 20°C               | 0.7893 g/ml    |
| Water solubility 20°C         | Very soluble   |
| Viscosity at 20°C             | 1.17 cP        |
| Specific heat, 20°C           | 0.579 cal/g°   |
| Combustion heat, 25°C         | 7092.1 cal/g   |
| Evaporation heat 78,32°C      | 200.6 cal/g    |

Source: Rizani, 2010.

Plants that have the potential for starch content can have potential as raw materials for ethanol production, such as breadfruit (Artocarpus artilis). The availability of breadfruit (Artocarpus artilis) in Indonesia is quite large and the starch content is quite high at 89%. In each fruiting season, the breadfruit commodity harvest reaches four to twenty tons/hectare.

For the people of Indonesia, the use of breadfruit (Artocarpus artilis) is still not optimal because it is only used as a snack. Based on the above background, breadfruit (Artocarpus artilis) was used as raw material for bioethanol. Making bioethanol from breadfruit substrate was done by hydrolyzing cellulose in breadfruit using hydrochloric acid (HCL) and fermentation using Saccharomyces cerevisiae.

2. Method

The test material used in the study was 3 kg of breadfruit which was obtained from Ngariboyo District, Magetan Regency. Breadfruit fruit was peeled, cut into pieces and dried, then mashed into breadfruit flour. Each sample of breadfruit flour as much as 40 grams per hydrolyzed using hydrochloric acid (HCL) with a concentration of 1%, 1.5% and 2% for 24 hours. After 24 hours each treatment was added 10% Saccharomyces cerevisiae with 72 hours, 120 hours and 168 hours fermentation. The following was the ethanol fermentation process carried out by the bacterium Saccharomyces cerevisiae (Lud Waluyo, 2004: 159).

\[ (C_6H_{10}O_5)_n + n\text{H}_2\text{O} \xrightarrow{\text{HCL}} (C_6H_{12}O_6) \]

Starch       Water       Glucose

After getting the results of glucose filtrate from the hydrolysis process, the glucose results was fermented to produce bioethanol with the help of Saccharomyces cerevisiae microbes with the following reaction equation:

\[ S. \text{cerevisiae} \]

\[ C_6H_{12}O_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2 \]

Glucose       Ethanol

According to Hambali et al. (2007: 40), bioethanol production includes three series of processes, namely preparation of raw materials, fermentation and purification. After fermenting, the sample was distilled and ethanol levels were measured using the specific gravity method.
3. Results And Discussion

The process of hydrolysis is the process of changing cellulosic molecules into glucose which was carried out with the help of a hydrochloric acid catalyst (HCL). HCL concentrations in this study were 1%, 1.5% and 2% with 24 hour hydrolysis time. Cellulose that had been converted into glucose would be converted into ethanol in the fermentation process by *Saccharomyces cerevisiae*. The fermentation time was 72 hours, 120 hours and 168 hours. Based on the research, the following results are obtained:

![Graph between bioethanol levels and fermentation time](image)

**Figure 1.** The graph between bioethanol levels and fermentation time

Based on Figure 1 above, it can be seen that the levels of bioethanol produced are increasingly increasing at ever-increasing HCL concentrations of 1%, 1.5% and 2% with a fermentation time of 72 hours, 120 hours, and 168 hours. This was because the reaction speed increases with increasing concentration acid used. So the higher the concentration of HCL used, the faster the hydrolysis reaction occurs and the starch molecules decomposed into glucose increases. Increased glucose levels will increase the level of ethanol produced.

The graph above shows the most optimum time for the results of the highest ethanol content occurred in the fermentation of 168 hours at a concentration of 2% HCL of 17.6087 and the results of the smallest ethanol content indicated at 72 hours fermentation at a concentration of 1% HCL of 3.7456. The high or the low concentration of ethanol produced in the fermentation process was influenced by various factors such as pH, glucose concentration as a substrate, starter concentration, and fermentation temperature. In addition, in general cellulose hydrolysis is more difficult when compared to polysaccharide hydrolysis, this is caused by complex interfacial heterogeneous hydrolysis processes that are influenced by several factors including the structure and composition of lignocellulosic adsorbs and desorption of cellulose enzymes, such as the presence of enzyme inhibitors such as cellobiose and glucose (Nobel, 1990 in Devi and Kumar 2012).

4. Conclusion

Based on the results of the study, it can be concluded that there is an effect of the concentration of Chloride Acid (HCL) and fermentation time on the levels of bioethanol from the breadfruit substrate (*Artocarpus artilis*). The best ethanol content was given by 2% HCL concentration and 168 hours fermentation time with 17.6% ethanol content.
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