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OPTIMASI PROSES FERMENTASI BIOETANOL | DELIGNIFIKASI KANDUNGAN SELULOSA KULIT JAGUNG MANIS MENGGUNAKAN METODE REFLUX

(OPTIMIZATION OF THE BIOETHANOL FERMENTATION PROCESS | DELIGNIFICATION OF SWEET CORN CELLULOSE CONTENT USING THE REFLUX METHOD)

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ABSTRACT

This study aims to determine the effect of time on the levels of bioethanol from sweet corn husks by the fermentation process. In future, optimize the delignification process by varying the concentration of NaOH. Results, ethanol levels were not detected. The delignification and fermentation stages probably influence this. In the delignification process, an error was made, namely the excess in the addition of distilled water and NaOH which should have been 1350 ml of distilled water and 150 ml of NaOH was added to all samples used. But here the use of 1350 ml of distilled water and 150 ml of NaOH is used for each sample. Reflux was carried out for 1,2 and 3 hours. Corn husk powder is washed with distilled water and dried. The replacement of washing with squeezing resulted in the presence of NaOH as well as the lignin content in the sample.

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Kata kunci: *kulit jagung manis, bioetanol, fermentasi.*

Main Figure

ABSTRAK

Penelitian ini bertujuan untuk menentukan pengaruh waktu terhadap kadar bioetanol dari kulit jagung manis dengan proses fermentasi. Sehingga pada penelitian selanjutnya ini bertujuan untuk mengoptimalisasi proses delignifikasi dengan variasi konsentrasi larutan penetralisasi NaOH. Berdasarkan tabel hasil analisa, kadar etanol tidak terdeteksi. Hal ini kemungkinan dipengaruhi pada tahap delignifikasi dan fermentasi. Pada proses delignifikasi kesalahan yang dilakukan yaitu kelebihan pada penambahan aquades dan NaOH yang seharusnya aquades sebanyak 1350 ml dan NaOH sebanyak 150 ml itu ditambahkan untuk semua sampel yang dipakai. Tetapi disini penggunaan aquades 1350 ml dan NaOH 150 ml digunakan pada setiap sampel. Refluks dilakukan selama 1,2 dan 3 jam. Serbuk kulit jagung dicuci dengan aquades dan dikeringkan. Penggantian pencucian dengan pemerasan, menyebabkan masih terdapat NaOH demikian juga kandungan lignin pada sampel tersebut.

INTRODUCTION

Vegetable oil fuel is a liquid fuel that can be used as an energy source known as Bioethanol [1]. One way to get bioethanol is through the process of fermentation and distillation of the fermented product [2] . This method is the newest alternative as a substitute for petroleum and is said to be one of the green fuels because it is renewable in process and low-carbon. The main source for making bioethanol is sugar which can be produced into ethanol [3]. The production of bioethanol includes three series of processes, namely hydrolysis, fermentation, and purification or distillation [3,4]. Several developments in bioethanol production from agricultural commodities include corn, cassava, molasses, and cassava [5,6]. Meanwhile, bioethanol can also be obtained from biomass waste such as corn husks, cassava, pineapple skins, banana peels, cocoa shells, and rice straw [6,7] by changing the complex sugars of starch or processed cellulose into simpler sugars or glucose [8].

Corn husk is part of the plant that protects the corn kernels, is light green when it is young and dries on the tree when it is old. In general, corn plants contain approximately 30% corn husk as useless waste, which is harmful to the environment if not handled properly. Corn husk has the potential to be used as a source of bioethanol because it contains 15.7% lignin, 36.81% cellulose, and 27.01% hemicellulose. The utilization of corn husks as bioethanol can also be used as an alternative solution to reduce environmental problems. The cellulose present in the corn husk will be isolated first to remove the lignin content or be delignified [7]. Delignification is a process of changing the chemical structure of lignocellulosic biomass with the aim of selectively degrading lignin so as to decipher its chemical bonds, both covalent bonds, hydrogen bonds, and van der Waals bonds, with other chemical components in lignocellulosic materials (cellulose and hemicellulose), and try to keep these other components intact. The delignification process can be carried out by chemical and biological heat. Thus, the remaining cellulose and hemicellulose substrates will be more easily accessible by decomposing enzymes, including hydrolytic enzymes [9].

Research on the manufacture of bioethanol from corncob waste with variations in hydrochloric acid concentration and fermentation time. The process of making bioethanol consists of pretreatment, hydrolysis, fermentation, and purification. Pretreatment or delignification was carried out by adding 0.1 M NaOH to corncob powder, adding NaOH to neutralize or remove lignin on the corn husk, which was then hydrolyzed using an HCl solution. The results showed that the higher the acid concentration, the higher the ethanol content [7]. Another research was about the production of bioethanol from rice straw (Oryza sativa L.) through several stages, namely delignification, hydrolysis, fermentation, and distillation processes. The hydrolysis stage uses various HCl concentrations and various fermentation times. Rice straw was hydrolyzed with HCl at concentrations (7, 14, and 21%). The hydrolysis results were then analyzed for glucose levels using a UV-Vis spectrophotometer. The highest glucose level was 70.85 ppm from hydrolysis with 21% HCl [8].

This study aims to determine the effect of time on the levels of bioethanol from sweet corn husks by the fermentation process. So that in future research, this aims to optimize the delignification process by varying the concentration of NaOH neutralizing solution. The delignification process is carried out to increase the ability of the surface area (porosity) of cellulose so that it can increase the conversion of cellulose into glucose (fermented sugar). In this study, NaOH solution was also used to remove the lignin content found in corn husks.

Bioethanol

Bioethanol is ethanol produced by fermentation using vegetable raw materials. Bioethanol can be made from biomass containing sugar, starch, or cellulose, which has been processed into glucose. Ethanol or ethyl alcohol (better known as alcohol) is a colorless, volatile, flammable, water-soluble, non-carcinogenic liquid. In general, the physical and chemical properties of bioethanol are as follows:

Table. 1 Physical and chemical properties of bioethanol.

Name	***Ethanol***
Molecular Formula	C_2H_5OH
Molecular Weight	46,07 gr/gr mol
Density	0,789 gr/cm3
Boiling Point	78,4 ℃
Flash Point	21 ℃
Critical Point	234,4℃
Melting Point	112℃

Melting Point	-114,3℃
Critical Pressure	63 atm
Form (25℃)	Colorless liquid
Cp (25℃)	0,69 kkal/mol
Volatility	Volatil

Bioethanol has the characteristics of being volatile, flammable, soluble in water, non-carcinogenic, and has no negative impact on the environment. Bioethanol has benefits for human consumption as an alcoholic beverage. In addition, bioethanol can be used as fuel with a minimum content of 10% ethanol [10]. Bioethanol production costs are relatively cheap because the source of raw materials comes from agricultural waste, which has low economic value. Ethanol can be produced from fermentation or fermentation of carbohydrates, where the principle of ethanol formation is the release of energy stored in organic materials that have a high carbohydrate content with the help of microbes. There are several types of microbes that have the ability to ferment ethanol, including yeast and bacteria. The process of forming ethanol with intermediary microbes runs anaerobically and for yeast runs microaerobically [11].

Bioethanol Manufacturing Process

Several studies on the manufacture of bioethanol from corncob waste with variations in hydrochloric acid concentration and fermentation time. The process of making bioethanol consists of pretreatment, hydrolysis, fermentation, and purification. Pretreatment was carried out by adding 0.1 M NaOH to corncob powder, which was then hydrolyzed using an HCl solution. The results showed that the higher the acid concentration, the higher the ethanol content obtained [12]. The production of bioethanol from lignocellulosic materials requires four main process units, namely pretreatment, to break down lignocellulosic bonds and separate lignin from cellulose and hemicellulose polymer chains. Hydrolysis, to hydrolyze polymers into monomers. Fermentation, fermenting monomers into ethanol using microorganisms, and finally purification, purification of ethanol through distillation and dehydration processes.

Chemical Reaction Process of Bioethanol

$$\underset{\text{(starch)}}{(C_6H_{10}O_5)n} \xrightarrow{\text{(Enzyme)}} \underset{\text{(glucose)}}{n\ C_6H_{12}O_6} \quad (1)$$

$$\underset{\text{(glucose)}}{(C_6H_{12}O_6)n} \xrightarrow{\text{(yeast)}} \underset{\text{(ethanol)}}{2\ C_2H_5OH} + 2\ CO_2 \quad (2)$$

Delignification Process

The delignification process is a process of removing lignin from biomass by processing it in an organic solvent medium where it is hoped that the lignin will dissolve in the solvent. During the delignification process, a reaction occurs that breaks the lignin macromolecular bonds by H^+ ions from the solvent, where the lignin bonds are released to form the lignin fraction, which then dissolves in the solvent, then the lignin is easily removed. If the main purpose of fractionation is to produce pulp, maximum delignification is required by solvent media so that pulp with high cellulose content is obtained. So far, the delignification of biomass in organic acid media is influenced by several operating conditions, such as solvent concentration, catalyst concentration, and reaction time. In addition, delignification depends on the type of biomass and organic solvents used [13].

Delignification is a process of changing the chemical structure of lignocellulosic biomass with the aim of selectively degrading lignin so as to decipher its chemical bonds, either covalent bonds, hydrogen bonds, or van der Waals bonds, with other chemical components in lignocellulosic materials (cellulose and hemicellulose), and try to keep these other components intact. The delignification process can be carried out by chemical and biological heat. Thus, the remaining

cellulose and hemicellulose substrates will be more easily accessible by decomposing enzymes, including hydrolytic enzymes. Delignification will open the lignocellulosic structure so that cellulose becomes more accessible. The delignification process will dissolve the lignin content in the material, thus facilitating the process of separating lignin from the fiber. The delignification process causes damage to the lignin structure and releases carbohydrate compounds [13].
The process of destroying the structure of materials containing lignocellulosic is one of the steps to convert lignocellulose into sugar compounds. Delignification processes are often used with the use of alkaline solutions. The use of alkaline or alkaline pretreatment solutions, such as the use of NaOH, can be used to help separate lignin from cellulose fibers. Alkali pretreats can increase cellulose content and is effective for removing lignin. Likewise, the use of NH_3 for delignification has been shown to be effective in many biomass raw materials. So the delignification process uses the reflux method. Reflux is one of the methods in chemistry to synthesize a compound, both organic and inorganic. Generally used to synthesize volatile or volatile compounds. In this condition, if normal heating is carried out, the solvent will evaporate before the reaction runs to completion. The principle of the reflux method is that the volatile solvent used will evaporate at high temperatures but will be cooled by the condenser so that the solvent, which was in the form of vapor, will condense in the condenser and fall again into the reaction vessel so that the solvent will remain during the reaction. [14].

Hydrolysis Process

Hydrolysis is the process of breaking a compound with water; there are four types of hydrolysis [15]. First, hydrolysis without a catalyst Grignard reagent is indispensable in the synthesis of dehydrolysis quickly and completely by water. Anhydrous acids, lactones, lactides, and those belonging to anhydrite as ethylene oxide are rapidly hydrolyzed only with water. The reaction of acetic anhydrous is faster between benzoate or phthalate, and acetyl chlorine is hydrolyzed more quickly than butyral bromide. Second, hydrolysis with acid From Kirchof's observation, starch can be converted into glucose by using acid. Branconnot hydrolyzes linen with sulfuric acid, and fermented sugar is obtained. The use of acids in hydrolysis will accelerate the hydrolysis of various materials such as esters, sugars, and amides. The addition of acid can speed up the reaction because the acid acts as a catalyst (H^+ ions are needed). Usually, those that are widely used for hydrolysis are hydrochloric acid and sulfuric acid. Third, hydrolysis with bases can be classified into two types, namely: Hydrolysis with bases at low concentrations. In this hydrolysis, hydroxy ions are catalysts, such as hydrogen ions as acid catalysts. This reaction takes place quickly until the desired reaction is formed. Hydrolysis with a high concentration of base. This alkaline hydrolysis takes place using sufficient caustic soda at high pressure and concentration. Fourth, hydrolysis with enzymes. Enzymes are proteins produced in living cells and used by cells to catalyze specific chemical reactions. Enzymatic hydrolysis is the process of breaking down polymers into their constituent monomers with the help of enzymes. The amylase enzyme is an enzyme that is able to lower the activation energy so that it can accelerate the breakdown of polysaccharide polymer chains into their constituent sugar monomers. There are several factors that affect the hydrolysis process, namely the catalyst, reaction time, temperature, and stirring [15,16].

Fermentation Process

Fermentation is a process of chemical change in an organic substrate through the activity of enzymes produced by microorganisms. The fermentation process requires a starter as a microbe that will be grown in the substrate. The starter is a microbial population in quantity and physiological condition that is ready to be inoculated in the fermentation medium. Fermentation can be done in two ways, namely, spontaneous and non-spontaneous. Spontaneous fermentation is that which is not added by microorganisms in the form of a starter or yeast in the manufacturing process, while non-spontaneous fermentation is that which is added by a starter or yeast in the manufacturing process. The results of the hydrolysis were fermented using baker's yeast (Saccharomyces cerevisiae). Saccharomyces cerevisiae is the most important yeast in fermentation because it is capable of producing high concentrations of alcohol and spontaneous fermentation.

The microbe of Saccharomyces cerevisiae can convert sugar into ethanol due to the presence of invertase and zymase enzymes produced by these microbes; with the presence of these two enzymes, the Saccharomyces cerevisiae microbe has the ability to convert sugar from the monosaccharide group as well as from the disaccharide group. If the sugar in the substrate is a disaccharide group, the invertase enzyme will hydrolyze the disaccharides into monosaccharides. After that, the enzyme zymase will convert these monosaccharides into alcohol and carbon dioxide. The more enzymes added, the greater the level of bioethanol produced because more glucose is converted to bioethanol. Microorganisms grow and develop activities to change the fermented material into the desired product in the fermentation process [12]. The optimum process of fermentation depends on the type of organism; adding factors that affect the fermentation process are temperature, initial pH of fermentation, inoculum, substrate, and nutrient content of the medium. A good medium for use as a fermentation medium is a pollard. Pollard is a wheat milling waste that has potential as animal feed because it contains protein, fat, mineral substances, and vitamins compared to whole grain but contains a lot of structural polysaccharides. The factors that influence the fermentation process are the type of microbes used. There are three important characteristics that must be possessed by microbes when they are used in fermentation [13] including pH (degree of acidity) [14].

Distillation

Distillation is a method of separating solutions based on differences in boiling points. The boiling point of pure ethanol is 78℃. The distillation process will increase the ethanol content up to 95%. The remaining water is removed by a dehydration process until the ethanol content reaches 99.5% (Yogamina, 2011). In distillation, the mixture of substances is boiled so that it evaporates, and this vapor is cooled back into liquid form. Substances that have lower boiling points will evaporate first. This method is a chemical unit operation of the mass transfer type [17].

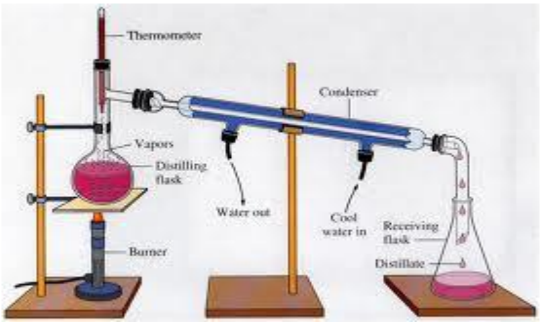

Figure 1. Series of distillation equipment

Characteristics of Bioethanol

Table 2. Characterization of Bioethanol SNI (7390-2008)

Parameter	*Unit, Min/Max*	*Specifications*	*Test Method (SNI 7390-2008)*
Ethanol content	%-v, min.	99,5 (before denaturation) 94,0 (after denaturation)	Sub 11.1
Methanol content	mg/l, max.	300	Sub 11.1
Moisture Content	%-v, max.	1	Sub 11.2
Denaturant	%-v, min. %-v, max	2 5	Sub 11.3
Content of Cu	mg/kg, max	0,1	Sub 11.4
Acidity as CH_3COOH	mg/l, max	30	Sub 11.5
Appearance of Chloride Ion	mg/l, max	Clear and no precipitate 40	Visual Observations Sub 11.6
Sulfur Content	mg/l, max	50	Sub 11.7
sap (gum), washed	Mg/100 L, max	5,0	Sub 11,8
pH		6,5-9,0	Sub 11.9

Characteristics of bioethanol include liquid, colorless, specific smell, flammable, and vapor that can mix with water in any ratio. Broadly speaking, the use of bioethanol is a solvent for organic and inorganic substances, the basic ingredient for the industry of acetic acid, esters, spirits, and acetal aldehydes. In addition, ethanol is also used for mixed drinks and is used as a renewable fuel [18].

The method or level of testing for bioethanol used has several ways to measure the content of ethanol, and each method of measurement has its advantages and disadvantages. Some of these methods are analysis using GC (Gas Chromatography), analysis with HPLC (High Performance Liquid Chromatography), and the alcohol hydrometer method. The alcohol hydrometer method uses a Figaro TGS2620 alcohol gas sensor. This tool is used to detect ethanol content in a liquid in a relatively short time and results that are close to accurate compared to other methods. This tool uses the ATMEGA8535 microcontroller as an analog-to-digital converter. However, due to equipment limitations, the analysis of alcohol content in this study was carried out by measuring the density of ethanol using a pycnometer in the laboratory. In addition to the above methods or tools, you can also use a % Brix Ethanol or Hand Brix Refractometer RHB-90 to measure bioethanol levels. This tool is a handheld binocular model brix measuring device that has a brix measurement range from 0 to 90% with a measurement accuracy of ± 0.2% brix. Brix is a dry substance dissolved in a liquid or solution and other similar materials. Brix is widely said to be an indicator of sugar levels or the level of sweetness of a substance being tested. This brix refractometer is widely used to measure sweetness levels or sugar levels and sweetness levels [18,19].

METHODS

The equipment used is a series of distillation apparatus, beaker glass, analytical balance, pH meter, alcohol meter, stove, pan, stir bar, measuring cup, three-neck flask, hot plate and stirrer, condenser, dropper pipette, measuring pipette, ball suction, Thermometer, Erlenmeyer, 50 mesh sieve. Corn husk, HCl solution (Merck), ammonium sulfate (Merck), NaOH solution (Merck), urea (Merck), baker's yeast (Saccharomyces cerevisiae), and distilled water. Preparation of Raw Materials (Pretreatment) with 20 kg of corn husk waste that has been provided, roughly cut into smaller parts as much as possible. Furthermore, the corn husks were washed with water and dried with the help of sunlight until dry. The dried corn husks were cut into 1 cm pieces. Corn husks were ground with a grinder and sieved through a 40-mesh sieve. Mashed corn husks were baked in the oven at 60℃ for 3 hours. Then sieved again using a 40 mesh sieve to obtain corn husk powder. Then the sieve results are weighed. Delignification was carried out by weighing 100 g of sifted corn husk powder and then adding 1350 mL of distilled water and 150 mL of 2% NaOH in an Erlenmeyer. Then refluxed for 1 hour, Corn husk powder with distilled water until neutral and dried. This procedure was repeated with various concentrations of NaOH 1% (w/v), 2% (w/v), and 3% (w/v) for 1, 2, and 3 hours. The hydrolysis process was carried out by adding delignified corn husk powder to 700 mL of 21% HCl solution. Then put, it into Erlenmeyer and heated at 100℃ for 3.5 hours. The fermentation process was carried out with the hydrolyzed filtrate put into 7 Erlenmeyer pieces of 40 mL each. Then 6M NaOH solution was added to each Erlenmeyer until the pH was 4.5. Each sample solution was added with 5.2 grams of ammonium sulfate and 5.2 grams of urea. Then pasteurized at 80 ℃ for 17 minutes and then cooled. Then added, 3 grams of baker's yeast (Saccharomyces cerevisiae). Next, each Erlenmeyer was wrapped in aluminum foil and then left to stand for 2-5 days at room temperature. The distillation process in this study used a set of distillation apparatus. The distillation process was initiated by filtering the fermented solution with filter paper, then placing the resulting filtrate into a three-neck flask and distilling it. The distillation process lasts until the temperature is ± 100 ℃ until the distillate no longer drips (runs away), leaving only residue (impurities). Then analyze the ethanol content of the distillation results obtained.

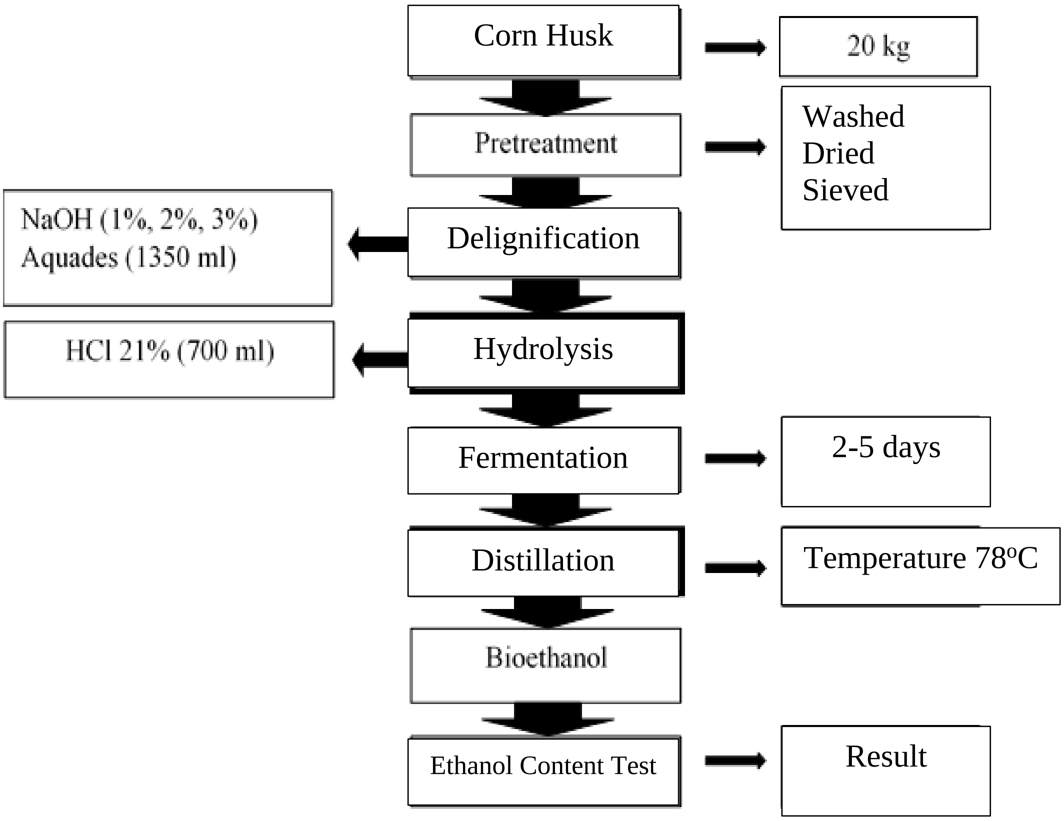

Figure 2. Research Flowchart

RESULTS AND DISCUSSION

20 kg of corn husks were taken at the Landungsari market in Malang, then washed and cut into 1 cm sizes. Furthermore, the corn husks are dried with the help of sunlight until dry. Then the corn husks were ground with a grinding machine, the corn husk mill took place at the Landungsari market, and the results of the corn husk grinding were 2 kg.


a).

b)

c).

d)

Figure 3. a). Corn husks before being cut and ground; b). Corn husk sieve ; c). Reflux results; d). Distillation results filtering process. The distillation results obtained in this study can be seen in table 1.

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Furthermore, the corn husk was sieved using a 50 mesh sieve; the sieving process was carried out three times because the corn husk still contained coarse fiber, so it was re-milled five times, then the corn husk powder was weighed as much as 900 grams to be baked at 100℃. The water content contained in the corn husk is reduced by heating the oven. Furthermore, the initial stage of making bioethanol is delignification. In the delignification process, 100 grams of corn husk powder from a sieve were weighed. Then, the corn husk powder added 1350 ml of distilled water and 150 ml of NaOH for each sample variation in Erlenmeyer. The reflux process was then carried out with variations of 1, 2, and 3 hours. In the reflux process, the liquid produced in each sample is gray, brown, red-brown, and black, while the odor produced is pungent. This delignification process uses the reflux method, which this reflux method functions to extract samples that have a rough texture, and withstand direct heating, in this case, lignin. Reflux results in this study can be seen in the table below.

Table 3. Concentration of NaOH 1, 2, 3% for 1 hour at temperature 80°C

NaOH concentration	*Time*	*Initial Temperature*	*Final Temperature*
1%	1 hour	80°C	81°C
2%	1 hour	80°C	82°C
3%	1 hour	80°C	83°C

Table 4. Concentration of NaOH 1, 2, 3% for 2 hours at temperature 80°C

NaOH concentration	*Time*	*Initial Temperature*	*Final Temperature*
1%	2 hours	80°C	85°C
2%	2 hours	80°C	85°C
3%	2 hours	80°C	85°C

Table 5. Concentration of NaOH 1, 2, 3% for 3 hours at temperature 80°C

NaOH concentration	*Time*	*Initial Temperature*	*Final Temperature*
1%	3 hours	80°C	87°C
2%	3 hours	80°C	88°C
3%	3 hours	80°C	89°C

From the data above, it can be concluded that during the reflux process, the temperature has increased. This is influenced by changes in time on each sample. So that in the reflux process, the temperature can also affect the speed of the reaction. Because the higher the temperature, the higher the reaction rate. Delignified corn husk powder in the form of a solid was added with 700 ml of 36% HCl solution. Then put it in Erlenmeyer and heat at 100℃ for 3.5 hours, then filter. The hydrolyzed filtrate is then fermented with variations of 2-5 days at room temperature. The result of the fermentation is a yellowish solution with a pungent odor. Then proceed with the distillation process to purify the fermented product, which is assumed to be bioethanol. The distillation process begins with filtering the fermented solution using filter paper. Then the filtrate is put into a two-neck flask and distilled.

Table 6. Distillation Results

%NaOH Concentration	*Volume of Distillate based on Time*		
	1 hour	2 hours	3 hours
NaOH 1%	-	0 ml	0 ml
NaOH 2%	1,4 ml	1 ml	2 ml
NaOH 3%	1 ml	0 ml	1,4 ml

Based on the data above, it shows that in the distillation or purification process, the volume of bioethanol in each sample changes. Then the next process is to analyze the ethanol content of the distillation results obtained. The results of the analysis of ethanol content can be seen in the following table.

Table 7 Results of Analysis of Ethanol Content

Sample Name	*Weight (gr)*		*Area*		*Ethanol*			
	Sample	ACN	Ethanol	ACN	Ratio Area	Measurable	Counted (g)	%
ETHANOL	0.5812	0.7838	-	17,200,461.07	-	-	-	<LOQ

Based on the table above, the results of the analysis of ethanol levels were not detected. This is probably influenced by the delignification and fermentation stages. During the delignification process, an error was made, namely the excess in the addition of distilled water and NaOH, which should have been 1350 ml of distilled water and 150 ml of NaOH, added to all samples used. But here the use of 1350 ml of distilled water and 150 ml of NaOH are used for each sample, and the next process is the reflux process for 1.2 and 3 hours. Then the corn husk powder is washed with distilled water until neutral and dried. But in this process, the washing of corn husk powder is not carried out and is replaced by squeezing using a white cloth. So that the NaOH solution is still attached and there is still lignin content in the sample. In the fermentation process, there is also an error, namely the length of the specified fermentation time. The time specified is actually 2-5 days, but here the time used is more than 2-5 days. So if the fermentation process lasts a long time, the ethanol content will decrease. Furthermore, also on pH measurements. The pH measurement should be 4.5, but here the pH obtained is more than 4.5, and there are also problems during distillation, namely, the temperature is not controlled properly.

CONCLUSION

Based on the results of the study, it can be concluded that there was an effect on the addition of excess material, and no washing process was carried out to remove the lignin content that was still attached to the sample. Effect of length of time on the fermentation process and also on the measurement of pH, which is not optimal. In order to pay attention to the addition of materials and also pay attention to the procedures or steps in conducting research in connection with the fermentation process, it is better if the time in the fermentation process must be according to the specified time so that Saccharomyces cerevisiae can reproduce properly and can maximally convert glucose into ethanol.

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