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ANALYSIS OF SEAWEED CARBOHYDRATE *Eucheuma cottonii* AND EFFECT ON THE HYDROLYSIS PROCESS AND FERMENTATION TIME IN PRODUCING BIOETANOL

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ABSTRACT

Research "Analysis of Seaweed Carbohydrate *Eucheuma cottonii* and Its Influence on Hydrolysis Process and Fermentation Time in Produce Bioethanol", conducted with the aim to know the value of carbohydrate seaweed type *Eucheuma cottonii* to get the correct hydrolysis and fermentation techniques so that the bioethanol produced more optimal. Seaweed bioethanol production process is liquefaction, scarification and fermentation. The tests were performed at each stage of bioethanol production including carbohydrate and glucose using SNI (1992), PH using PH meter, sugar content using refractometer (brix) and alcohol content using Alcoholmeter. Testing alcohol levels performed on fermentation day 3rd, 4th and 5th. The results showed that the functional component of carbohydrate constituent seaweed type *Eucheuma cottonii* is kappa carrageenan. Technical hydrolysis in the production of bioethanol is water, because water is the main carrageenan solvent. The best fermentation time is on the 5th day with 7% bioethanol content.

Keywords: *fermentation; hydrolysis; Seaweed carbohydrate*

1. INTRODUCTION

Fossil fuel oil, whether premium, diesel, or kerosene is a non-renewable fuel that takes millions of years to reshape, is polluting the environment with its glass house effect and its supply continuity is not guaranteed. On the other hand global demand for energy continues to increase. According to the World Energy Council, energy consumption tends to rise by 50% by 2020. (TIMNAS Development of BBN, 2008). The energy problem for human survival is a major problem faced by almost all countries in the world.

Bioethanol (C2H5OH) is one of the biofuel that comes as an alternative fuel that is environmentally friendly and renewable. Increasing the use of bioethanol as one

alternative energy source will have an impact on the increasing demand for raw materials. Sources of bioethanol raw materials can be divided 3:

- Starchy material, in the form of cassava or cassava, sweet potato, sago flour, corn kernels, sorghum seeds, wheat, potatoes, ganyong, arrowroot, bulb dahlia, and others.
- Sugary ingredients, such as molasses (sugarcane molasses), cane juice, cane juice, coconut palm, sweet sorghum juice, palm juice, palm nira, gewang, palm juice and others.
- Cellulosic materials, in the form of waste logging, agricultural waste (rice straw, bagasse, corncobs, tapioca waste, banana stem, sawdust, and others.

Production of bioethanol with plant raw materials containing starch or carbohydrates, is done through the process of converting carbohydrates into sugar (glucose). Seaweed includes high-carbohydrate commodities. Seaweeds grow and spread almost throughout the waters of Indonesia, both including macro-algae and microalgae. One type of seaweed cultivated in Indonesia is *Eucheuma sp*. The uniqueness of the physical properties and chemical composition of seaweed provides many possibilities for a wider new application of seaweed as bioenergy feedstock, therefore the use of seaweed as bioethanol feedstock is very suitable to be applied because it is supported by cultivation business which is increasingly encouraged and supported by cycle Short production. Where harvesting can be done at age 45 days.

The purpose of this study is to know the value of functional carbohydrates constituent seaweed species *Eucheuma cottonii* to get the appropriate hydrolysis and fermentation techniques so that the resulting bioethanol more optimal.

2. RESEARCH METHODS

Ingredients

The materials used in the bioethanol production process are:

a. Raw materials: seaweed type *Eucheuma cottonii*
b. Auxiliaries: bean sprouts, sugar, yeast (*Sacharomyces cereviceae*).

Tools

The equipment used is: Pot as liquefaction container, bottle as container of fermentation, PH meter, refractometer, alcoholmeter.

Work Procedure

a. Seaweed bioethanol production process is as follows:

- Liquefaction is the cooking stage with the addition of seawater: water (1:50). Further cooked until boiling / until the seaweed dissolves, into seaweed porridge
- Scarification is the stage of adding enzymes into the extract of seaweed at a temperature of about 90^0C. To break the polysaccharide into glucose.
- Fermentation, carried at a temperature of about 30^0C, by adding about 0.02% yeast. Further fermented anaerobes for 5 days.

b. Testing

The tests were performed at each stage of bioethanol production including carbohydrate and glucose using SNI (1992), PH using PH meter, sugar content using refractometer (brix) and alcohol content using Alcoholmeter. Testing alcohol levels performed on fermentation day 3, 4^{th}, and 5^{th}.

3. RESULTS AND DISCUSSION

The process of bioethanol production begins with the cooking process, with the addition of water as much as 50 times the weight of seaweed. Cooking done until boiling, where seaweed dissolves into seaweed porridge. The purpose of the addition of water as much as 50 times the weight of seaweed used is to assist the breakdown of polysaccharides contained in seaweed into other monosaccharides. According Sastrohamidjojo (2009) and Gaman & Sherrington (1994). Polysaccharides are condensation or condensation polymers of monosaccharides and are composed of many monosaccharide molecules bonded to each other, releasing a water molecule for each bond formed.

$$(C_6H_{10}O_5)\ n + nH_2O \rightarrow nC_6H_{12}O_6$$

Glucose Water Polysaccharide

In Winarno (1996) says, seaweed *Eucheuma cottonii* produce kappa carrageenan. Kappa carrageenan is stable in a gel state and hydrolyzed when heated in a neutral or alkaline PH state. While in Figures and Suhartono (2000) mentions, water is the main solvent of carrageenan. All carrageenan soluble in hot water at temperatures greater than 70^0C. The results of the Triwisari (2010), shows the extraction of seaweed using water can dissolve some of the content of ash and carbohydrates.

Next to the seaweed porridge is added the bean sprouts and sugar, to condition a comfortable atmosphere for the breeding of *Saccharomyces sp.* during the fermentation process. At the fermentation stage occurs a simple sugar-breaking process into ethanol by involving Saccharomyces sp. In this process the sugar will be converted to ethanol and carbon dioxide gas. The fermentation process lasts for 3-5 days.

$$\underset{\text{Glucose}}{C_6H_{12}O_6} \xrightarrow{\text{yeast}} \underset{\text{ethanol}}{2\ C_2H_5OH} + \underset{\text{carbondioxide}}{2CO_2}$$

The composition of carbohydrates and monosaccharides at each stage of the process, can be seen in the Table 1.

Table 1. Change of Chemical-Physical Composition at Each Stage of Bioethanol Production.

Types of Sample	Carbohydrate (%)	Glucose (%)	Sugar Content	PH	Alcohol (%)
Dried Seaweed	23,43	26,02	-	-	-
Seaweed Porridge	16,95	18,78	2,3	7.06	-
Seaweed Porridge + Sari Tauge	14,32	15,89	2,0	6,68	-
Porridge Seaweed + Sari Tauge + Sugar	16,60	18,44	3,0	5,97	-
Fermentation Results	0,01	0,01	0,2	4,87	7

Carbohydrate values describe the amount of functional component content in this case the carrageen contained specifically by this type of seaweed. Carrageenan is a linear or straight polysaccharide, and is a galactant molecule with its main galactose unit (Winarno, 1996). In Apriyantono et al. (1989), mention that polysaccharides and lignin that are not digested by humans are included in dietary fiber. Seaweed is known as one type of plant that has low lignin levels (Kim *et al*.2005). This situation provides the ease

of exploration of seaweed included in the production of bioethanol, because lignin is a difficult component in degradation so that it can inhibit the extraction process.

From the table above shows that there is a good decomposition of carbohydrates into monosaccharides until the fermentation process that can take place quite well, where the rest of the carbohydrate and glucose content of fermentation is 0.01%. While the content of bioethanol fermentation is 7%.

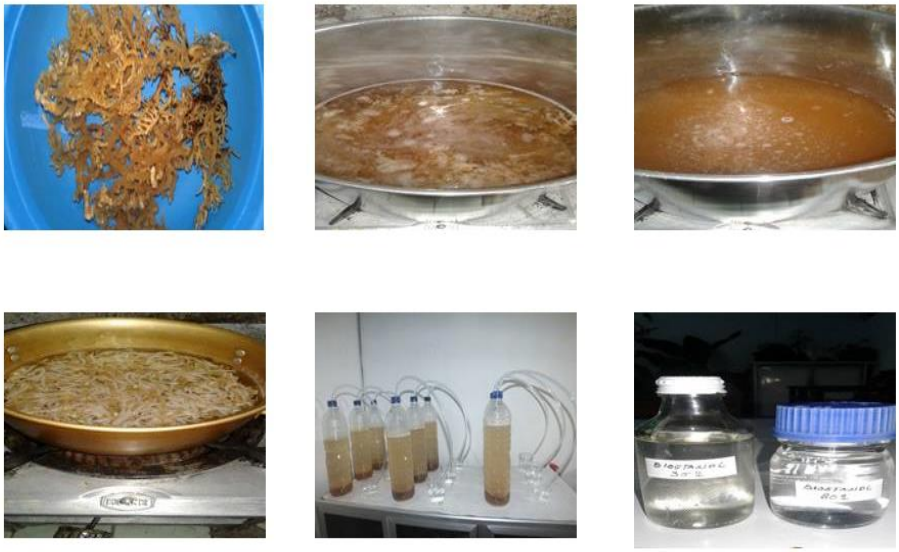

Figure 1. The samples preparation and their fermented bioethanol testing.

Testing of fermented bioethanol on the 2nd, 3rd, 4th and 5th days. While the test by using alcoholmeter on day 2, has not been detected. On day 3 detected 2%. On day 4 detected 5%. While on day-5 obtained alcohol level of 7%. Thus the best fermentation time is on the fifth day (five).

4. CONCLUSION

Based on the result of research can be concluded that:

a. The functional component of carbohydrate constituent of seaweed type *Eucheuma cottonii* is kappa carrageen.
b. Technical hydrolysis in bioethanol production is water, because water is the main carragenen solvent.
c. The best fermentation time is on the 5th day with 7% bioethanol content.

REFERENCES

Angka S L dan M T Suhartono, 2000. Bioteknologi Hasil Laut. PKSPL. IPB. Bogor.

Apriyantono A, Fardiaz D, Puspitasari N L, Sedamawati, Budiyanto S, 1989. Analisis Pangan. Bogor. Pusat Antar Universitas, IPB.

Producing Biofuel Using Sea Algae. Seoul, World Intelectual Property Organization

Sastrohamidjojo, H, 2009. Kimia Organik. Stereokimia, Karbohidrat, Lemak dan Protein. Gadjah Mada University Press.

Sherrington K B dan Gaman P.M , K.B Sherrington , 1994. Ilmu Pangan. Pengantar Ilmu Pangan Nutrisi Dan Mikrobiologi. Gadjah Mada Universitas Press.

Standar Nasional Indonesia, 1992. Cara Uji Makanan Dan Minuman. SNI 01 – 2891 - 1992. Badan Standarisasi Nasional.

Timnas Pengembangan BBN, 2008. BBN Bahan Bakar Nabati. Bahan Bakar Alternative dari Tumbuhan sebagai Pengganti Minyak Bumi & Gas .Eka Tjipta Foundation. Penebar Swadaya.

Triwisari D A, 2010. Fraksinasi Polisakarida Beberapa Jenis Rumput Laut. Fakultas Perikanan dan Ilmu Kelautan. IPB. Bogor.

Winarno, F.G. 1996. Teknologi Pengolahan Rumput Laut. Pustaka Sinar Harapan.