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Process for Obtaining Green Algae Oil As A Resource Development Effort Alternative Raw Materials on Biodiesel Production Process

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Research Article

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ABSTRACT

Microalgae have received much attention as a renewable energy source. Microalgae have high potentials in biodiesel production compared to other oils crops. First, the cultivation of microalgae does not need great areas as compared to that of Terraneous plants. Biodiesel produced from microalgae will not compromise the production of food and other products derived from crops. Second, microalgae grow extremely rapidly and many algal species are rich in oil. Because of the reasons they reason, we used Green Algae as microalgae in this experiment. The osmotic method was chosen because microalgae are multispecies and a multi-cell microorganism with the semipermeable membrane, which is delicate in osmotic pressure shock. Green Algae can grow well in 20 - 40°C in slightly alkaline solution and highlight intensity roommates are suitable in Indonesia's weather. Acid chloride as a solvent was chosen because of their highest osmotic pressure effect due to their semipermeable membrane. Also, percolation method used as the reference method, this method is usually adopted in pharmacy industries to recover volatile oils. 77.236% - weight of algae oils in this study was extracted using ethanol as a solvent. The percentage of oil by ethanol was bigger than to the HCl-osmotic method, only 71.218% - the weight of oil was extracted by the osmotic method. With increasing the number of solvents, the time of mixing and the higher molarity of the solution will be the rise of algae oil. The yield of algae oil by hydroalcoholic phase and operation time. 37.63% water in hydroalcoholic phase Contain give 76.584% the weight of oil. The solvent types are used also roommates influence the algae oil composition, especially the composition of the FA, MG, DG, and TG and pigment compounds in the oil.

INTRODUCTION

In many algae contained organic materials such as types of polysaccharides, hormones, vitamins, minerals, oils and bioactive compounds. So far, only limited use of algae as a commodity for the industry. Whereas chemical materials contained in the algae are very beneficial to the food industry raw materials, cosmetics pharmaceuticals and others [1-5]. Another advantage possessed by algae is not needed agricultural equipment, such as on land, in the cultivation of algae, without seeding, CO_2 gas produced can be used as fuel and the harvesting crops continuously given the short time of planting algae is one week [6,7]. The advantages of algae and other extracted with the aid of solvents (CO_2 extraction, ultrasonic extraction, and osmotic). Prediction Schultz et al. will be produced algae oil amounted to 7,660 liters per hectare of algae is grown [8]. This figure is greater than the vegetable oil derived from plants for the same land. Algae are common in the waters of algae, red algae, brown algae, blue-green algae and so forth. In addition, various types of algae like *Griffthsia, Ulva, Enteromorpha, Gracilaria, Euchema,* and *Kappaphycus* have been as much as a source of food or as a source of bioactive compounds. However, various types of algae mentioned above are very vulnerable to fluctuating environmental conditions. While Algae Greens, one of a kind Cyanobacteria/blue-green algae, especially the physical and chemical environments such as light intensity, water temperatures, salinity, and limitations will nutrients the Green Algae is one of the factors that affect the growth of the Green Algae [9]. In addition, environmental temperature also affects elevated levels of lipids in the Green Algae. Increasing the temperature up to 35°C at Green Algae maxima will increase the linolenic acid content of up to 11-16% than with plantesis Green Algae, increasing the acid content reaches only 12-14% of the increase in temperature up to 30°C [9].

However, algal oil as an alternative feedstock biodiesel production is still limited to discourse that needs to be studied and explored in depth for continuing can be developed as an alternative feedstock biodiesel production. Therefore, it is necessary to do studies on the potential of algae oil as a raw material alternative biodiesel production. The purpose of this research is to extract green Algae in order to obtain algae oil, which in turn produces algae oil yield and purity are high.

MATERIALS AND METHODS

The extraction is done using a laboratory scale three-necked round bottom flask fitted with the cooler, thermometer and magnetic stirrer. The reaction temperature is maintained at 30°C using a water bath and atmospheric pressure. Then to the extraction done by two different methods, namely: osmotic (solvents NaOH and HCl) and percolation (ethanol). The research variables were investigated as follows:

Osmotic method (solvent NaOH), studied the effect of solvent volume (75, 150, and 200 mL), concentration (0.5, 1.5, 3, 5 M) and the extraction time (60, 90, 120, 150, 180 And 360 minutes). As for the osmotic method (solvent HCl), studied the effect of solvent volume (75, 150, and 200 mL), concentration (0.5, 1.5, 3, 5 M) and the extraction time (60, 90, 120, 150, 180 and 360 minutes). As for the percolation method (75, 150, and 200 mL) and extraction time (60, 90, 120, 150, 180 and 360 minutes). In addition, extraction using Soxhlet with n-hexane solvents are used as comparison method and the basis of calculation of algae oil yields obtained. Then, the main research material, Algae Green dry is a commercial product and reagents used are pure an analysis, include: ethanol, HCl, and n-hexane. Flow diagram of the study for both methods is shown in **Figures 1 and 2**.

RESULTS AND DISCUSSION

Osmotic Method (Solvent NaOH)

The osmotic extraction method is performed by solvents NaOH and HCl solvents. The results show NaOH solvents cannot be used as a solvent for oil extracts obtained from a colloidal making it difficult for algae oil refining process. The colloidal system is formed together with the oil and finally broken up in the atmosphere of bases (Na+). Proteins with an amino acid group that is a base such as an arginine, lysine, and histidine forming a positive charge if it is in an alkaline environment [10]. Average Green Algae has a high protein content, 60 - 70% weight. The protein has gelling properties (gel forming) with the critical concentration of gelling is 1.5% w (weight) compared with w in an aqueous solution [11]. In addition, there are also hydrophobic properties owned by the structure of the protein complex. The presence of the disulfide bonds in the protein structure of the Green Algae, causing the hydrophobic properties of the structure. This hydrophobic interaction, that stabilizes the system in a Green Algae gel protein. It was also mentioned by Rachmaniah et al. that algae oil gives greater results using ethanol solvents compared to HCL solvents [12]. Given the high concentration of Green Algae protein gelling concentration is surpassed and finally obtained an extract of oil in the form of a gel which cannot be purified in the separation process.

Osmotic Method (Solvent HCl)

The use of solvents HCl gives different results compared to the solvent NaOH. This is possible due to the protein content in Green Algae is more alkaline than acidic. So there is no precipitation and gelling of proteins, as has happened in the solvent NaOH. Solvent extraction using HCl shows an increase in algae oil yields obtained by increasing molarity solvent used **(Figure 3)**. Molarity high solvent shows at least the water content and the rich content of HCl in the solution. The high acid content (solute) in the solvent will affect the Green Algae cell osmotic pressure, resulting in water in the cell will move to the solvent and finally through lysis/abdomen or bloating. Lysis of the cells will be to extract more oil from the pockets of oil in the cell. Solvent extracted oil at low molarity HCl is worthless. Less acidic levels (the amount of solute minimum), will reduce, the amount of oil extracted due to osmotic pressure in the cell is not disturbed. So that the cells do not undergo lysis/wrinkle or bloated and finally extracted oil is not maximal. In some cases, the breakdown of cells is needed, thereby increasing the yield of the desired [13]. It's given the location of the energy storage cell (oil) is in the mitochondria impenetrable by the solvent. On the use of HCl 0.5 M, volume 75 mL, oil yield obtained for 23.065% HCl 5 M- weight while at the same volume, acquired 25.706% -weight. In addition the extract of algal oil extraction with solvents HCl bluish green. Different color extracts obtained during use ethanol, P.A. The occurrence of the oil color difference for Green Algae contains green (chlorophyll) and a blue dye (picosianin) [11]. The pigment bound to some kind of protein. Successful protein material extracted from algae contains a dye that binds covalently to proteins. So that the pigment components of a supramolecular complex form of the protein is surrounded by the dye. Pigments in Green Algae are classified into three classes, namely: chlorophyll-a is 1.7% of the weight of the cell; Carotenoids and xantofil, is 0.5% by weight of organic cells; and phycobiliprotein, c-picosianin, and allopicosianin, represents 20% of the protein structure and the predominant pigment in Green Algae [11]. In the group of cyanobacteria (blue-green algae, such as green algae), phycobiliprotein is the intact cell membrane joining the cytoplasmic surface of thylakoid in the chloroplasts **(Figure 4)**. So that when the cell rupture, phycobiliprotein

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split into many colors, fluorescent, became sub-complex water-soluble binder polypeptide. But basically, the dye does not interfere with the quality of the oil obtained [11].

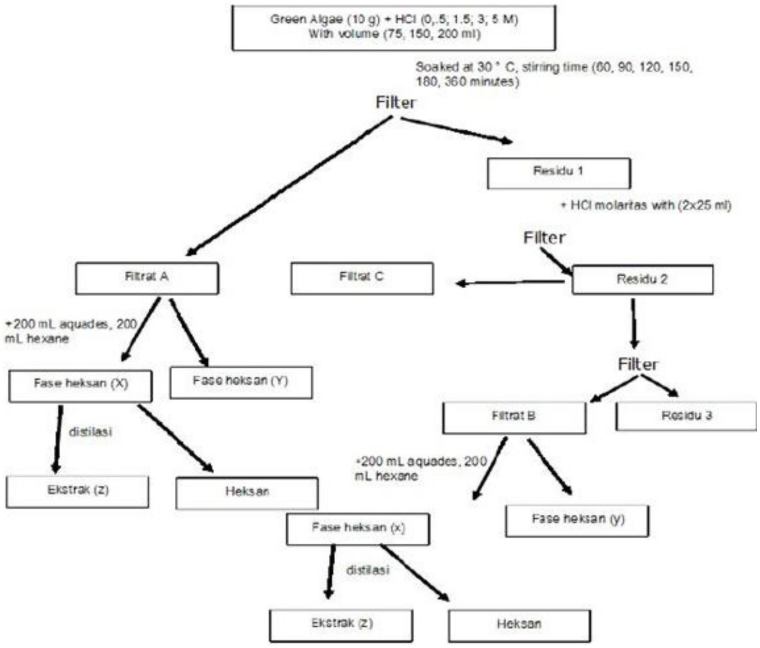

Figure 1. Flow diagram osmotic methods with solvents HCl.

Percolation Method (Ethanol p.a 99.8%)

Extraction using ethanol pa gives a yield of oil is higher than the yield obtained when using solvent HCl yield oil green algae obtained by ethanol pa, 75 mL, 3 hours of percolation of 77.785% while solvent HCl 5 M with the number of solvents and same soaking time oil yield of 25.706%. In addition, the extracted oil percolation method results in green. This shows its extractable dye of the Green Algae (chlorophyll) by ethanol. Fajardo et al. explain that the water content in hydroalcoholic phase (Q) by 40% provides optimum oil yield. In 75 mL ethanols, the water content reaches 36.52%, whereas in ethanol with a volume of 150 mL of water content 26.31%. At the ethanol solvent of 200 mL of water content reached 22.12% [14]. This is why the oil yield in ethanol is 75 mL greater (77.785% - weight), while the yield on subsequent algae oil is produced from ethanol, 150 mL (37.722% -weight), and the last of ethanol, 200 mL (23,866% Weight).

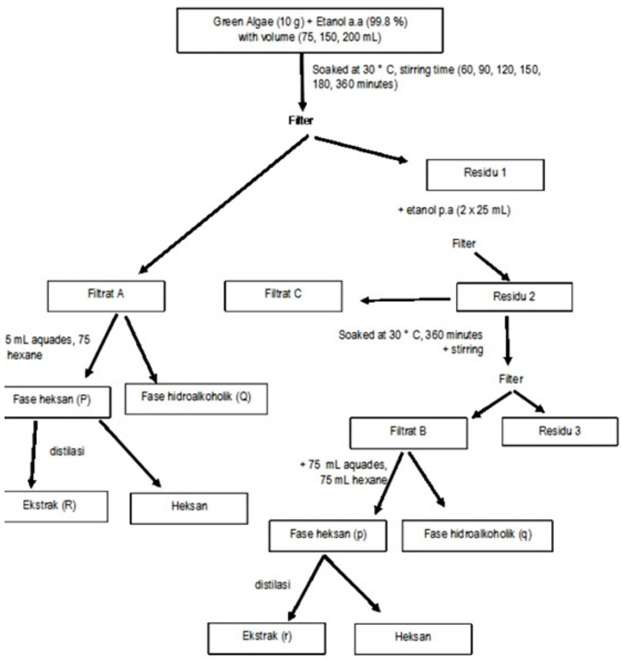

Figure 2. Flow diagram osmotic methods with solvents ethanol (99.8%).

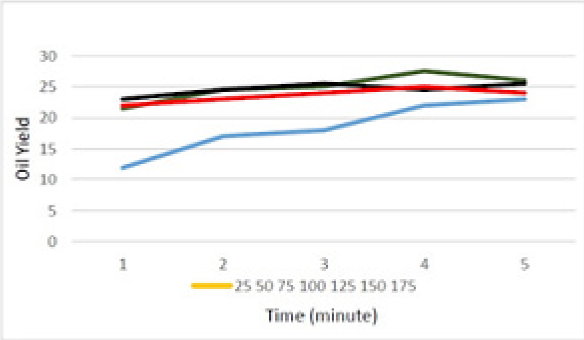

Figure 3. Algal oil yield (%- weight) of the extracted (osmotic) using a variety of solvents HCl molarity and stirring time is different.

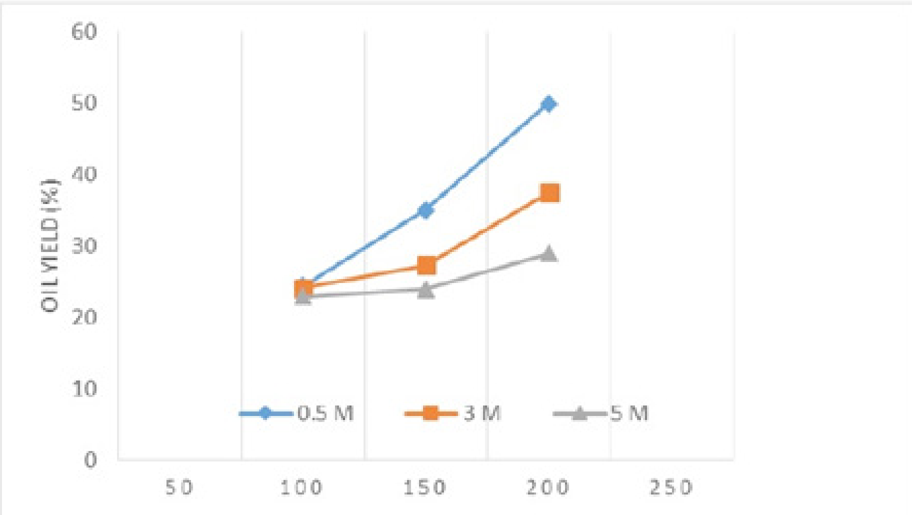

Figure 4. Yield algae oil extraction process (osmotic) using solvents HCl obtained at various volume HCl with stirring time of 3 hours.

Table 1. Oil yield (%) extraction with ethanol (99.8%) in various volumes.

Oil yield (%) extraction with ethanol (99.8%) in various volumes. Volume solvent (mL)	Oil Yield (%-weight)	The water content % (phase hydroalcoholic/Q)
75	77,785	36,52%
150	37,722	26,31%
200	23,866	22,12

Table 1 shows the greater volume of ethanol, the smaller the oil yield obtained. As noted previously, the high water content in hydroalcoholic phase (Q), **(Figure 2)**, will lower the lipid extraction yield due to the formation of emulsions. The presence of an emulsion between oil and ethanol will complicate the process of separation. The water content in a hydroalcoholic phase (Q) should be considered because of the high water content (>40%) led to the difficult formation of two phases (phase and phase hydroalcoholic hexane). When the level of water in the phase hydrocaloholic >40%, the two phases will form the crude extract was added hexane and distilled water allowed to stand for ± 2 days. In addition to the influence of water content in hydroalcoholic phase (Q), the acquisition of the oil yield of algae succession caused damage to lipid-protein complexes and break the circuit lipids by ethanol. However, the type of alcohol participating solvents to extract some contaminants such as sugars, amino acids, salts, and pigments [13].

Table 2 shows the oil yield increases with the increase in the percolation time. Percolation longer time will maximize the contact between the solvent (ethanol) with the solute so that number of successful oil extracted by solvents [14]. Similarly, if you use a solvent HCl **(Table 3)**. However, the yield of oil will be constant after 20 hours of extraction [15-18].

Table 2. Oil yield (%) extraction with ethanol (99.8%), 75 mL with immersion time 3 and 6 hours percolation condition.

Oil Yield (%) extraction with ethanol (99.8%), 75 mL with immersion time 3 and 6 hours percolation Condition	Soaking Time (hours)	Oil Yield (%-weight)
Etanol p.a 75 mL	3	77,785%
	6	78,347%

Table 3. Oil yield (%) solvent extraction with HCl 5 M, 75 mL with immersion time 3 and 6 hours percolation condition.

Oil Yield (%) solvent extraction with HCl 5M, 75 mL with immersion time 3 and 6 hours percolation condition	Soaking Time (hours)	Oil Yield (%-weight)
Etanol p.a 75 mL	3	26,817%
	6	72,347%

CONCLUSION

The extraction of algae oil with ethanol (99.8%) (78.347% weight) gives a yield far more oil than the solvent HCl 5 M (72.347% - weight). The solvent volume, while stirring and the solution molarity effect on the acquisition of oil yield for the type of solvent HCl. The more the volume of solvent used, the longer the stirring time and the higher the molarity of the solution is its oil recovery yield. The water content in the hydroalcoholic phase (Q) and the soaking time affect the acquisition of the oil yield of ethanol (99.8%). The water content of 36.52% on hydroalcoholic phase (Q) gives a yield of 78.347% - weight oil.

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CONFLICT OF INTEREST

In this article there is no "conflict interest", either in relation to the contents of the text, tables, graphics and location of the research, or matters related to the title of the article. The Author asserts that this article is free of the Conflict Interest.

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