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Synthesis And Characterization of Bio-Fuel From Algae

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ABSTRACT

Biofuel is produced from different sources they have their own application and limitations and there study is related to transesterification process. In the era fuel production is not a big approach but when using some renewable sources it may affect in a fuel world. This type of studies have revealed to a novel side of innovation world. Bio-fuel from algae feedstock are the third generation of biofuel known as one of the most important renewable energy sources. Today global demand of fuel generated the opportunity to explore new renewable biomass source. Algae have shorter growth cycle as compared to other plant hence the algae is very promising source of biomass for the production of biofuel and also reduce in climate change effect. This review mainly focused on research related to the bio fuel production. Where the algae have acted as a most fast growing supporter of Bio Fuel and also define the Bio-Fuel production potentially higher than other crops.

Keyword: - Bio-fuel, Microalgae, Algae, Transesterification.

1. INTRODUCTION:

Energy is one of the most important factors to global prosperity, in view of continuously rising petroleum costs and dependence upon fossil fuel resources, considerable attention has been focused on alternative energy resources, hence the production of liquid bio-fuels which has been advocated as a sustainable option to tackle the problems associated with rising crude oil prices, global warming and diminishing petroleum reserves. Usage of this first generation feedstock for Bio-Fuel production leads to various discussion about increasing food prices and occupation of agricultural land. These problems are solved partially by using second generation feedstocks lignocellulosic materials such as waste or forest residues. Second generation feedstocks have some advantages over first generation feedstocks due to not being used as food source and less land requirement. However their harvesting, purification and various pre-treatment needs made their production quite challenging and not economical. Algae which are the third generation feedstock for bio-fuels are an alternative for the first and second generation feedstocks due to their productivity, easily cultivation and convenient harvesting time. Recently, they are mostly utilized for bio-diesel production because of their high lipid content.

1.1 Microalgae as a Potential Source of Bio-Fuel:

There are several ways to convert microalgal biomass to energy sources, which can be classified into biochemical conversion chemical reaction, direct combustion and thermochemical conversion. Thus, microalgae can provide feedstock for renewable liquid fuels such as biodiesel and Bio-Fuel. The idea of using microalgae as a source of bio-fuel is not new, but is now being taken seriously because of the rising price of petroleum and, more significantly, the emerging concern about global warming that is associated with burning of fossil fuels. The utilizations of microalgae for bio-fuels production offers the following advantages over higher plants: (1) microalgae synthesize and accumulate large quantities of neutral lipids (20-50 % dry weight of biomass) and grow at high rates; (2) microalgae are capable of all year round production, therefore, oil yield per area of microalgae cultures could greatly exceed the yield of best oilseed crops; (3) microalgae need less water than terrestrial crops therefore reducing the load on freshwater sources;

1.2 Objective of the research work:

The aim of our proposed project work is to be produce bio-fuel from third generation feedstock i.e., algae to reduce the burden on first and second generation bio-fuel feedstock such as corn, wheat, potatoes, paddy rice, etc., as well as to curb the emission of greenhouse gases by providing cleaner fuel substitutes to reduce the effect of climate change by further providing energy efficient processes.

The main objective is

- To establish and design a complete process for an effective and eco- friendly bio-fuel fuel for providing a viable substitute to petrol as well as for blending purposes.
- To synthesis bio-fuel at laboratory scale.
- ➢ To study the composition and characterization of the obtained bio-fuel product.

2. SYNTHESIS OF BIODIESEL FROM MICROALGAE:

The chemicals used n-hexane, methanol fuel and naoh were of analytical grade. The chemical were used without any further purification.this complete experiment is carried out in the laboratory of chemical department, college of engineering and technology, Akola.

Algae sample collection:
The samples were collected from babhulgaon, akola. The sample collected from an open pond.

Fig -1: Collection and drying of Algae

2.1 Procedure :

Preparation of oil extraction:
The samples were spread under the sun in the roof of the hostel for 2 days (48 hours) to evaporate the amount of water. The dried samples were ground with the help of grinder and the fine powder was passed through different micron sieves, to get different mesh size algal biomass. The ground algae were dried for 30 min at 80°c in an incubator for releasing leftover water. Then the algae powder was stored in different jars for extraction experiment in a sealed container.

Oil extraction from algae:

The algae samples collected was dried (100%) and powdered. Hexane was mixed with the dried ground algae to extract oil in separating funnel of 250 ml. Then the mixture was kept for 24 h for settling and for separation of the two layers in the funnel. The organic phase containing the algae oil was emptied in the pre weighted 50 ml beaker. The algal oil was separated from algae biomass by filtration and weighted it by using electronic weight balance. The extracted oil was evaporated in a water bath to release hexane. All extraction was performed in triplicates for the different parameters solvent extraction process. The oil yield (wt. %) was then calculated by utilizing the following equation Extracted oil efficiency (wt. %) = (mass of oil extracted (grams) /the total mass of dried algae)*100

Transesterification method:

Transesterification is a chemical reaction used for the conversion of triglycerides (fats) contained in oil into usable biodiesel. Transesterification occurs via two steps using homogeneous base catalyst and the second step using heterogenous acid catalyst. The two types of catalyst used where sodium hydroxide (NaOH) and potassium hydroxide (KOH) 0.5-2.0% of wt. of oil.

The experimental set-up consist of a 4.5 cm i.d. Glass reactor of 100 ml capacity, equipped with six-bladed turbine impeller. The entire reactor assembly was immersed in a thermostatic water bath, which was maintained at the desired temperature with an accuracy of 5 c. The reaction temperature was monitored with help temperature controller. The reactor was also equipped with a condenser to reduces losses of methanol fuel due to evaporation . The agitation was provided by means of an electric motor having provision for speed control the mixture of refined oil and fuel was first feed to reactor and stirred at known rpm , after attainment of the desired temperature , the immobilized enzyme of known quantity was added .sample from the reaction mixture drawn at regular interval of time samples of the reaction mixture were centrifuged to remove immobilized lipase before analysis.

Fig. 2 : Bioreactor Set for Transesterification Reaction

2.2 PERFORMANCE AND RESULTS:

Experiments have been performed using the constant mass and dried algae and by changing the volume of solvent. Derived results are then tabled in the table1. As it can be seen that increasing the solvent amount also improve the extracted oil efficiency.

Table 1: Amount of Lipid extracted by varying volume of Solvent used

Sample	Algae biomass (g)	N-hexane (ml)	Algae to n-hexane ratio	Lipid extracted (g)	Extracted efficiency %
01	30	30	1	0.79	2.63
02	30	40	1.33	0.92	3.07
03	30	50	1.66	1.57	5.23

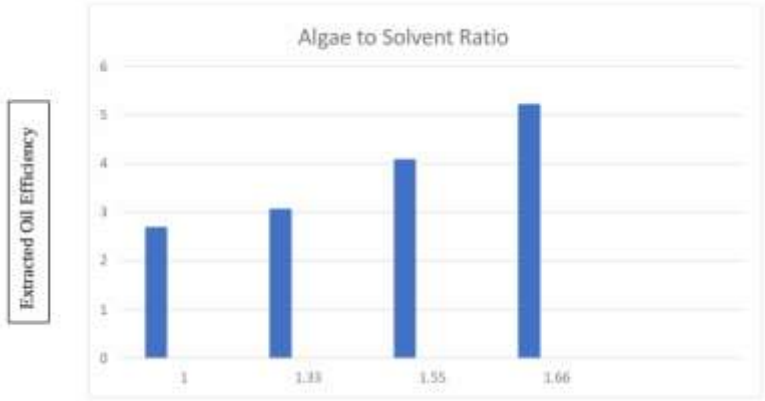

Chart 1: Amount of Lipid extracted by varying volume of Solvent used

Final Product after Transesterification Process:

Final Product(Biodiesel)

3. Comparison of Properties Produced biodiesel with Petro Diesel :

Table -2 : Comparative of Properties

Sr no.	Properties	Petro diesel	Produced biofuel
1	Density(kg/m^3)	861	876.2
2	Kinematic viscosity (mm^2/s)	1.3-4.1	4.9
3	Flash point (°c)	60 – 80	140
4	Fire point (°c)	68 – 82	160
5	Cloud point (°c)	-15 - 5	5

4. CONCLUSIONS :

Microalgae offer great potential as a sustainable feedstock for the production of third generation bio-fuel. The extraction of carbohydrate from microalgae biomass is essential to produce third generation bio-fuel and the efficiency of this process is depend on distinct factors, such as morphology and algae species. In the production of bio-fuel from microalgae and to make this process viable, it is important to take into account other aspects, such as improving the culture condition to enhance the accumulation of different compounds of interest, application of the culture water in the pretreatment, and the use of solvents or catalyst that are environmentally friendly. Technological development, including advances in photobioreactor design, microalgal biomass harvesting, drying and processing are important areas that may lead to enhanced cost-effectiveness and therefore, effective, commercial implementation of the bio-fuel from microalgae strategy.

6. REFERENCES :

1. Brennan, L. and P. Owende, 2010. Biofuels from microalgae—A review of technologies for production, processing, and extractions of biofuels and co products. Renewable and Sustainable Energy Reviews,14(2): p. 557-577.
2) Demirbas, A. and M. Fatih Demirbas, 2011. Importance of algae oil as a source of biodiesel. Energy Conversion and Management, 52(1): p. 163 170.
3) Scott, S.A., M.P. Davey, J.S. Dennis, I. Horst, C.J. Howe, D.J. Lea-Smith and A.G. Smith, 2010. Biodiesel from algae: challenges and prospects. Current Opinion in Biotechnology, 21(3): p. 277-286.
4) Arun, J., Shreekanth, S.J., Sahana, R., Raghavi, M.S., Gopinath, K.P. and Gnanaprakash, D.,2017. Studies on influence of process parameters on hydrothermal catalytic liquefaction of microalgae (Chlorella vulgaris) biomass grown in wastewater. Bioresource technology, 244: p. 963-968.
5) Varma, M.N., P.A. Deshpande, and G. Madras, 2010. Synthesis of biodiesel in supercritical alcohols and supercritical carbon dioxide. Fuel, 89(7): p. 1641-1646.
6) Kumar, S.J., Kumar, G.V., Dash, A., Scholz, P. and Banerjee, R., 2017. Sustainable green solvents and techniques for lipid extraction from microalgae: A review. Algal Research, 21: p. 138-147.
7) Barnwal, B.K. and M.P. Sharma, 2005. Prospects of biodiesel production from vegetable oils in India. Renewable and Sustainable Energy Reviews, 9(4): p. 363-378.
8) Chen H, Zhou D, Luo G, Zhang S, Chen J, 2015. Macroalgae for biofuels production: progress and perspectives. Renewable and Sustainable Energy Reviews, 47(1): p. 427- 437.
9) Santos, F.F.P., S. Rodrigues, and F.A.N Fernandes, 2009. Optimization of the production of biodiesel from sobean oil by ultrasound assisted methanolysis. Fuel Processing Technology, 90(2): p. 312- 316.
10) Khan, S.A., Hussain, M.Z., Prasad, S. and Banerjee, U.C., 2009. Prospects of biodiesel production from microalgae in India. Renewable and Sustainable Energy Reviews, 13(9): p. 2361-2372
11) Topare, N.S., Raut, S.J., Renge, V.C., Khedkar, S.V., Chavanand, Y.P. and Bhagat, S.L.,2011.Extraction of oil from algae by solvent extraction and oil expeller method. International Journal of Chemical Sciences, 9(4): p. 1746 1750.
12) Konga, A.K, A.S. Muchandi and G.P. Ponniah, 2017. Soxhlet extraction of Spirogyra sp. Algae: an alternative fuel. Biofuels, 8(1): p. 29 – 35.
13) Fatima, N., Mahmood, M.S., Hussain, I., Siddique, F. and Hafeez, S., 2016. Transesterification of oil extracted from freshwater algae for biodiesel production. Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 38(15): p. 2306-2311.