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Analytical study of Phytoplanktons as a key drive for Biofuels

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ABSTRACT

This study aimed to evaluate the lipid content and the ensuing capability of various microalgae present in the Mauritian marine water to create biodiesel.The expedition for an alternative source of energy by the collaborator opened on to the discovery of Biodiesel as a perfect alternative source for energy which challenges conventional fossil fuel to proficiency and accessibility. Biodiesel blooms as the best alternative source of energy in comparison with Diesel due to its some physiochemical properties like Higher flash point, cetane number, high calorific value, Kinematic viscosity, etc. Second-generation feedstock vegetable oils, some non-edible oil like Jatropha, neem seed oil, castor seed oil, rubber seed oil were mostly used for the production of Biodiesel. which can lead to Food vs Fuel crisis as well as land crisis. In this research Phytoplaktons like algae and Cyanobacteria are used as the feedstock of third-generation for preparing Biodiesel, which will deal with all problems like food vs fuel crisis, land problems, as well as carbon assimilation problem, etc. hence, will be ecofriendly. Biodiesel production from microalgae is a promising method, with the benefits of high biomass yield with high lipid content. Challenges incorporate compelling methods to gather the developed microalgae, extraction of the algal oil, and its transesterification to biodiesel. In situ transesterification of dry green growth to unsaturated fats methyl esters (FAMEs) was accomplished utilizing ultrasonication. A Gas Chromatograph was utilized to investigate the FAMEs. Biodiesel delivered through 20 minutes of in situ transesterification yields up to 3.769 mg of FAMEs per g of dry algal.

Keywords-*Microalgae, Phytoplanktons, Biodiesel, PUFA analysis for medicinal properties*

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INTRODUCTION

Global energy is rising due to continuous exploitation of fossil fuels being a non-renewable source and still, high dependency of the energy sector on fossil fuel is leading to environmental and social concerns like unpredictable weather change and energy security as well have a huge impact on the scarcity of fossil fuels, and hence raising the price of fuel oil in the world. Diversification of the energy source can be the one solution to solve it and at the same time saving the environment is also a matter of concern. The present circumstance has made the vast majority of the nations on the planet (one of them is India) look for wellsprings of elective fuel that can be created from other fundamental materials that are inexhaustible and climate amicable. Hence, to meet the level of oil utilization and support the turn of events and usage of inexhaustible elective energy, (biofuels) for example, biodiesel is utilized. Governments and policymakers by knowing the high demand for green and sustainable energy, promote several energy plants that stimulate the implementation of low-carbon technologies. To accelerate the plan towards sustainable green energy many researchers are focusing on the all-feasible aspects for the development of clean and renewable fuels. Due to an emerging market and rapid growth, the production of oil from biodiesel will continue to be a worthwhile business. In this context, biofuels are anticipated to play a vital role especially in automobile industries for transportation.

Biodiesel nowadays has become a globally important renewable source of energy. Biofuels can be produced through a wide range of feedstock using various technologies. Out of all confirming feedstocks, phytoplanktons are most acceptable as it has enormous benefits as compared to other conventional biomass. Among all of this phytoplanktons do not compete with the food sector as well in terms of land since they show rapid growth and can be cultivated in arid land or even non-arable land, and it has numerous medicinal benefits too.

India has a large water area, which is rich in aquatic biological resources, research on microalgae as a natural substance of biodiesel, particularly freshwater or terrestrial phytoplankton, has been carried out.

In any case, research on the way of life of phytoplankton that delivered fats for biodiesel utilized as base material is still more uncommon, especially fresh water phytoplankton *Chlorella vulgaris.*
Chlorella vulgaris has a fairly high-fat content between 5-40% under optimal growth conditions and proliferation and up to 58% under unfavorable conditions.
For biodiesel creation, lipids and unsaturated fats of regular sources must be removed from dry biomass of them like microalga biomass. Extraction strategies like ultrasound and, microwave helped were additionally utilized for oil extraction from regular sources. Biodiesel is a combination of unsaturated fat alkyl esters gotten by transesterification (ester trade response) of vegetable oils or creature fats. Biodiesel looms as expected substitutions of petrodiesel [1]. It is an inexhaustible and elective fuel delivered from a transesterification response among alcohol and unsaturated fats (FAs) from animal fat or vegetable oil within the presence of a catalyst [2]. Chemically, biodiesel particles comprise a long chain of mono-alkyl esters. Biodiesel can be utilized straightforwardly (100 percent named B100) in any diesel motors with no adjustment or mixed with diesel fuel at various volumes proportion such as 5% biodiesel in combination (B5), 20% Biodiesel in blend (B20), 50% biodiesel in combination (B50, etc).

MATERIAL AND METHODS

Materials: The material used in this research work include phytoplankton cultures derived from *chlorella vulgaris* and *chlorella sorokiniana* (UTEX 1230 & 265 kindly provided by R&D center Faridabad), chemistry Laboratory, Ramjas college Delhi university, Pond water, Dairy waste collected from various resources, K_2HPO_4, $MgSO_4.7H_2O$ $CaCl_2.2H_2O$, Citric acid, ammonium ferrous citrate, EDTA, Na_2CO_3, $NaNO_3$, Boric acid, $MnCl_2.4H_2O$, $ZnSO_4.7H_2O$, sodium molybdate dihydrate, $CuSO_4.5H_2O$, Cobalt nitrate.
Methods Used: the different methods used for the research in this paper are cultivation and harvesting, solvent extraction method for Production of Algal oil from microalgae Biomass and Transesterification method is used for the formation of biodiesel, Gas Chromatograph, HP integrator, GREET software used for formation of fatty acids methyl esters.

RESULT AND DISCUSSION

Cultivation and Harvesting
Both species were first inoculated in the Photosynthesis Laboratory at Ramjas college Science Department. These inoculations were refined in little glass containers of 25 - 50 ml. The development culture for each strain was checked by straightforward perception. After the inocula arrived at the fixed stage, they were moved to the Biodiesel Laboratory for screening. After fourteen days, broth concentration and oil content were estimated utilizing a Bausch and Lomb spectrophotometer and Varian SF-330 spectrofluorometer separately. Both undigested and processed examples were applied in equal trials for examination to the necessities of water-powered maintenance times, expulsion efficiencies of nitrogen, phosphorus, and compound oxygen interest (COD), biomass productivities, and CO_2 sequestration capacities. however, didn't outperform altogether the measure of CO_2 sequestered on 15 days premise in light of the better usefulness acquired in undigested dairy compost [3]. Phytoplanktons *chlorella vulgaris* was decanted and then filtered and further dried in solar drier system.

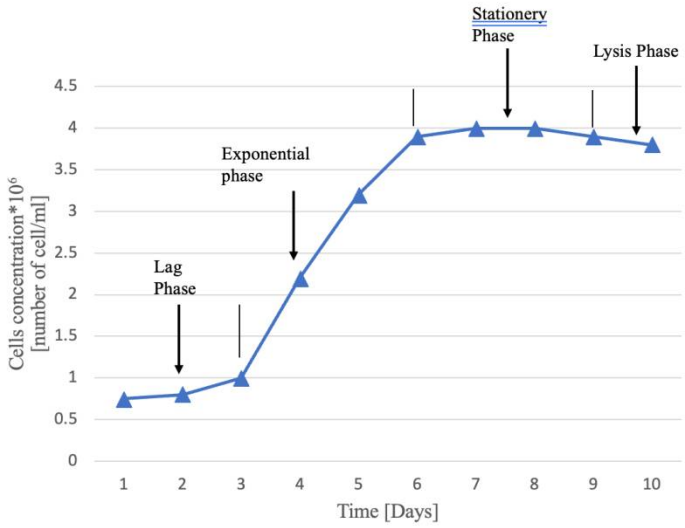

Fig 1: Growth Phases of Chlorella Vulgaris.

Production of Algal oil from microalgae Biomass:

It is extracted from dried biomass by using solvent extraction method, for this one of the dried biomass is first crushed weighed by using mortal and pastel and then bead beaten(milling)and mixed with hexane and kept in Sonicator, while other dried biomass is mixed with Chloroform, methanol, and water in the ratio of 2:1:0.3 and kept in Sonicator to extract cyclohexane and methanol layer separately by decanting and repeating the same process 3-4 times. Intense Sonication of liquids generates sound waves that propagate into the liquid media resulting in alternating high and low-pressure cycles.

Transesterification

An aliquot of 1 to 5 g of dry algal biomass made an appearance in a 250 ml glass container that was joined with 40 ml of 0.1 N KOH in methanol. The combination was sonicated utilizing an ultrasonic W375 Sonicator set to give a power thickness of 9.3 W/ml with a beat obligation pattern of the half. The response time (transesterification time) was changed for ideal biodiesel yield. The volume of methanol (0.1 N KOH in methanol) was kept steady at 40 ml for the finish of the transesterification response.

Lipid estimation and FAME analysis: Lipid extraction and FAME (Fatty acid Methyl Ester) analysis was carried out for both the samples harvested for 45 days. For lipid extraction, Bligh and Dyer's method was followed.

Table 1: For 45 days

Sample code	Lipid(mg/g)	Lipid% of dry mass
265	34	3.4
1230	10	1

Table 2: For 30 days

Sample code	Lipid(mg/g)	Lipid % of dry mass
265	150	6
1230	150	12.6

Table 3:For 25 days

Sample Code	Lipid(mg/g)	Lipid% of dry mass
265	150	3.3
1230	150	8.66

The time for the transesterification interaction was about 180 minutes. While the response happens, the heating temperature ought to be kept up with. Besides, the results of the transesterification were left for 3-4 days to shape two phases. Then, at that point, it isolated and followed by the expansion of anhydrous Na_2SO_4 to the methyl ester to pull the remainder of the water in the arrangement. The following stage was to isolate Na_2SO_4 of biodiesel by utilizing rotators. Supernatants in the structure of methyl esters (biodiesel) were taken and afterward warmed in an oven at a temperature of 70°C. Hence acquired pure biodiesel was then dissected physical and synthetic properties to decide the nature of the biodiesel.

Analysis of Chemical properties of extracted oil through spectroscopy: Analysis of the compound properties are content of free unsaturated fat (% FFA), saponification worth, and iodine value.

Lipid Analysis of Biodiesel

The combination FAMEs guidelines were ready by pooling 100 µl of each of the following standards: C 16:0, Cl 8:0, C 18:1, C 18:2, Cl 8:3, and C 19:0 bringing about the last grouping of 6.7 mg/µl each. 1 µl of the mixed drink standard was infused in the HP 5890 Series II Gas Chromatograph (GC) to distinguish the maintenance season of each unsaturated fat methyl ester (FAME) present in the combination. Figure 2 shows show maintenance seasons of C 16:0, C 19:0, and every single C 18. C 18:1, C 18:2, and C l8:3 were not very much isolated in this strategy. Their peaks overlapped in one peak when there were in a mixture.

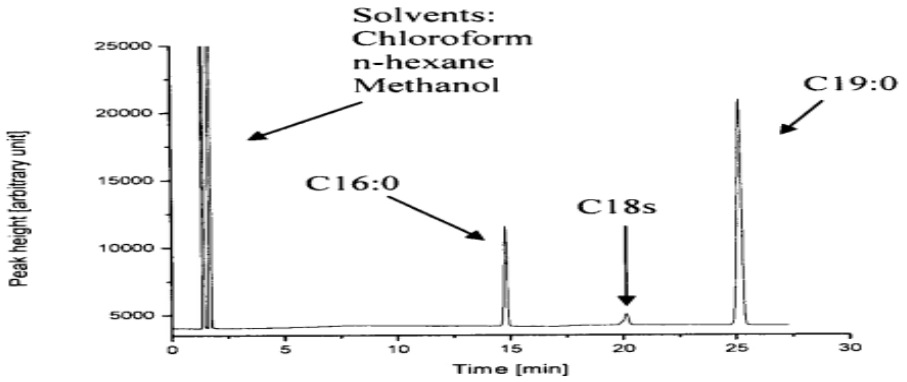

Figure 2: FAMEs peaks of mixture standard. 1 µl of mixture standard injected intothe GC, GC data analyzed.

Table 4 Comparison of different emissions for different cell growth in different samples collected

	In BG-11	In Pond water	In Mother dairy milk waste product	Diluted BG-11
	Cell count $720*10^4$	Cell count $144*10^4$	Cell count $120*10^4$	Cell count $64*10^4$
VOC	4.85g	0.9694g	0.8079g	0.4275g
NOx	16.24g	3.2487g	2.7073g	1.4178g
PM10	2.17g	0.43337g	0.3614g	0.1898g
PM2.5	1.68g	0.3357g	0.2797g	0.1558g
SOx	17.47g	3.4943g	2.9119g	0.9508g
CO2 Total	10.55kg	2.1106Kg	1.7588Kg	0.9384g
N2O	5.45g	1.0893	0.9077g	0.4873g
POC	0.96g	0.1915g	0.1596g	88.5383mg
CO2-Biogenic	-18.72kg	-3.745Kg	-3.1208Kg	-1.6651kg
GHG-100	16.72kg	3.3445KG	2.7871Kg	1.4895kg
Biomass	852MJ	170MJ	142MJ	76MJ
Coal fuel	45MJ	9040KJ	7534KJ	3866KJ
Fossil fuel	182MJ	36MJ	30MJ	16MJ
Natural gas fuel	109MJ	22MJ	18MJ	10MJ
Biogas	7885KJ	1577kJ	1314KJ	700.9098KJ
Whole algae biomass	851MJ	170MJ	142MJ	76MJ
CH4	0.54g	0.1084g	90.3034mg	70.661mg
SOx	4.12g	0.8247g	0.6873g	0.1396g
VOC urban	0.24g	47.1627mg	39.3023mg	20.2472mg
CO2 total urban	3.11kg	0.6214kg	0.5178Kg	0.275Kg
NOx urban	1.62g	0.3235g	0.2696g	0.1669g
PM10 urban	0.17g	34.34mg	28.6183mg	18.4209mg
PM2.5 urban	0.14g	27.079mg	22.5659mg	15.5868mg
GHG-100	3.14kg	0.6271kg	0.5226Kg	0.2786Kg

CONCLUSION

By using GREET software It has been concluded that Biodiesel produced from microalgal strains are useful in controlling Carbon emission. Higher biomass gives a higher value of VOC(volatile organic Compound), GHG(Greenhouse gases), NOx, SOx, Fossil fuel, Natural fuel, etc, which are given maximum by BG-11 medium.

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