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Sustainable production of Biofuels from Nitzchiaceae Girna River Dist. Jalgaon Maharashtra, India

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Abstract

The sustainable investigation results to obtain high quality biodiesel from microalgae, family Nitzchiaceae through transesterification. Due to continued demand of petroleum fuels, wildly uses and unstable deleting the supplies as well as continued accumulation of CO_2 in environment, by considering all these problems, biodiesel necessary for environment and economic stability. Microalgae play an important role with this problem and providing row material to produce the biodiesel. Biodiesel able to absorb CO_2 from the atmosphere and making the environment pollution free. Microalgae having capacity to convert these simple substances in the atmosphere, absorbing sunlight and convert into chemical energy , microalgae having the capacity to reproduce or double in biomass within two to three days or 2 to 3 hrs. Remaining biomass also be used as nutritional supplement and fodder for animals. There are some problems on production of biodiesel on large scale or industrial level, like cost of production of dry biomass and oil extraction.

Keywords: Microalgae, Girna river, Biofuels, Nitzchiaceae, Transesterification, Absorb CO_2.

Introduction

Algae are the fast growing plants in the world, it live in wild range, abundantly distributed in aquatic ecosystem. Algae are naturally found in aquatic as well as terrestrial ecosystem. In terrestrial ecosystem found in soil, rocks, air and snow. In aquatic ecosystem found in fresh as well as marine water. They are in different range in length, width and structure. Algae are simple structural aquatic plants that possess chlorophyll a, b, c, caritonoid and xanthophylls as their primary photosynthetic pigment and can produce their own food through to process of photosynthesis.

Algae are photosynthetic organism capable of absorb sunlight as well as fixing CO_2 from atmosphere to produce biomass in large amount as compared to terrestrial plants. Numerous algal strains have been shown in the laboratory to produce more than 50% of their biomass as were converted to biofuels, it would replace only about 4.5% of the total petroleum diesel[1,2]. The energy is need for us, it play vital role in our daily life. A country standard living is considered to be proportional to the energy consumption by the people of that country[3].

Energy is one of the vital input of the socioeconomic development of any country. It runs all activity of the country development. The energy simply available around us should be identify, convert, store, amplify and use it for our use in a variety of ways. Energy production has always been a concern for researchers as well as policymakers. Concerns about shortage of fossil fuels, day by day increasing crude oil prices, increasing CO_2 in atmosphere, increasing global warming energy security have led to growing worldwide interest in renewable energy sources such as biofuels as key to reducing reliance on foreign oil, lowering emission of green house gases, mainly CO_2, methane and meeting rural development goals[4].

India is become popular as fastest growing country in the world. The some development objectives focus on economic growth, industrial, equity and human wellbeing, energy is key of socioeconomic development. To meet the needs and supply we should have work on production on biodiesel, microalgae is one of the best solution of this gap. Microalgae are unicellular and simple multicellular photosynthetic micro-organisms. They have high growth rates and photosynthetic efficiencies due to their simple structures[5]. It is estimated that the biomass productivity of microalgae could be 50 times more than that of terrestrial plants[6]. Biofuels production using micro algal farming offers the some advantages.

Microalgae able to grow quickly in mineral rich water with doubling time as short as 3.5 hours or shorter than. They produce abundant biomass, it contain up to 70% lipid[7]. The phenomenon makes the microalgae a more efficient biofuels producer than terrestrial plant sources. As an aquatic species, algae do not require land for cultivation and will not compete with agricultural commodities for growing space. Generally algae has cultivated in marine land, that has very less uses. Water used in algal cultivation can be fresh water or saline with salt concentrations up to twice that of seawater. Algae have greater capacity to purify the polluter water. This means that, it help the environment pollution free in atmosphere as well as in water. After oil extraction remaining biomass can be used as animal fodder or can make high protein food, if then also biomass left, it can be decompose easily to make manures[8]. There has now waste partials left in the atmosphere.

Materials and Methods

Algal sample were collected from the source places by using phytoplankton net and transported to the laboratory for analysis. The identification for the species, their composition and abundance was quantified and qualified under an invented microscope at 300x magnification[24] using standard keys for East African plankton[9].

The identified algal sample were used for culture acclimatization, three microalgae such as *Nitzschia frustulum, Nitzschia tryblionella* v. *levidensis* and *Nitzschia philippinarum* were collected from Girna river from Jalgaon region and used for the recovery of biodiesel. The cultures were grown in laboratory in controlled environment (30 psu, 8.0 pH) using Conway medium[10]. The sterilized medium was kept for 24 hrs before inoculating microalgae for CO_2 equilibration. For culture of microalgae, 10 L of medium was placed in 15 L plastic container incubated for 15 days at 26 ± 1°C with aeration through mechanical stirrer and 12 h photoperiod by artificial light. The biomass of the cultures was estimated for every 24 h by measuring the optical density at wavelength of 680 nm[11].

Transesterification of Algal Oil into Biodiesel. this method is normally done with Ethanol and sodium ethanolate serving as the catalyst for extract oil from microalgae. Sodium ethanolate and ethanol enter in the cell of microalgae and extract oil from cell, they have doing the function as catalyst to increase the rate of reaction to produce bio-diesel and glycerol[12]. The end products of this reaction are hence biodiesel, sodium ethanolate and glycerol. This end-mixture is separated with Ether and salt water are added to the mixture and mixed well. After sometime, the entire mixture would have form two layers, with the lower layer containing a mixture of ether and biodiesel. This layer is separated. Biodiesel is in turn separated from ether by a vaporizer under a high vacuum. As the ether vaporizes first, the Biodiesel will remain. The biodiesel from algae is now ready for use[13,14].

Results and Discussion

In the present investigation, *Nitzschia frustulum, N. tryblionella* v. *levidensis* and *N. philippinarum* have been selected as species mainly because they are showing significant characters in this study, with respect to quantitative and qualitative estimates of growth rate and flocculation activity, cell biomass productivities and their lipid content enhance biodiesel productivity. These three microalgae species were incubated for 15 days for biomass production.

The diagrammatic representation of Nitzschia frustulum, Nitzschia tryblionella v. levidensis and Nitzschia philippinarum were determined from parallel cultures starting from inoculums. Cell growth was started from the 1st day itself and it reaches maximum at 12th day of the culture. The growth rate of *Nitzschia frustulum* (0.835 g/L) was higher compared with *N. tryblionella* v. *levidensis* (0.457 g/L) and *N. philippinarum (0.379 g/L)* whose nearest results were observed in the culture of *Botryococcus braunii*[15].

The concentration of (NAOH) was paying key role for flocculation of parameters, flocculation activity experiments were undertaken to determine the effect of pH and optimum flocculent concentration on the flocculation of algal cells cultured for one week.

The flocculation efficiency of *Nitzschia frustulum, N. tryblionella* v. *levidensis* and *N. philippinarum* cultures were increased while increasing pH from 8.5 to 9.5. During the initial stage of flocculation process, when the pH of medium was increased, the small particles aggregated and slowly settled due to gravitational force. The cells formed large loose. Further addition of fluctuation of forms a layers of aggregate particles. This in turn might cause higher settling rates with minimal addition of flocculants[16].

Investigation result shows flocculation activity of *Nitzschia frustulum, N. tryblionella* v. *levidensis* and *N. frustulum* was higher at pH 9.5. Similarly, the microalgae *B. braunii* exhibited maximum flocculation activity at pH 9.8 to 11[17]. These results (Figure-2) suggest that pH adjustment of the culture solution after 1 week is the most effective recovery of lipid. The most effective harvesting process for the recovery of *B. braunii* is pH adjustment (pH 11) after 2 weeks of incubation and higher pH levels were effective in algal sedimentation[2].

The extracted greenish oil content (20-35% oil/g of dry algal biomass) from harvested algae was (Table-1) determined by measuring weights of extracted oil and it was found to be 40.26, 27.00 and 26.13% of biomass of *Nitzschia frustulum, N. tryblionella* v. *levidensis* and *N. philippinarum* respectively. The biomass concentration and oil content of *Nanochloropsis* sp.[18]. and *Neochloris oleabundans*[19], were similar to *Nitzschia frustulum, N. tryblionella* v. *levidensis*.

In the present study, the higher yield of biodiesel was obtained in the *Nitzschia frustulum, N. tryblionella* v. *levidensis*[20]. Moreover, 40.13% of biodiesel yielded from 0.835 g/L contains 40% oil content from *Nitzschia frustulum* and 27% of yield from 0.457 g/L contains 25% oil content, whereas, 55.3% of biodiesel was achieved from *Chlorella protothecoides* after 144h[21].

The characters of biodiesel obtained from *Nitzschia frustulum, N. tryblionella* v. *levidensis* and *N. philippinarum* are shown in Table-1. The properties of biodiesel from *Nitzschia frustulum* were; density 0.835 (kg/L), viscosity 3.1 (Pa.sat 40°C), heating value 41 (MJ kg/L) and H/C ratio 1:83, whereas the properties of *N. tryblionella* v. *levidensis* were; density 0.457 (kg/L), viscosity 4.7 (Pa.sat 40°C), heating value 42 (MJ kg-1) and H/C ratio 1:79 and properties of *N. philippinarum* were; density 0.379 (kg/L), viscosity 4.7 (Pa.sat 40°C), heating value 43 (MJ kg/L) and H/C ratio 1:81. Thus, the physical and fuel properties of biodiesel from microalgae were comparable to those of diesel fuel[22].

The biodiesel from algal oil showed much lower cold filter plugging point of -10°C which clearly indicated the high quality of the biodiesel[23]. The results suggest that the new process was a low-cost, feasible, and effective method for the production of high quality biodiesel from microalgae.

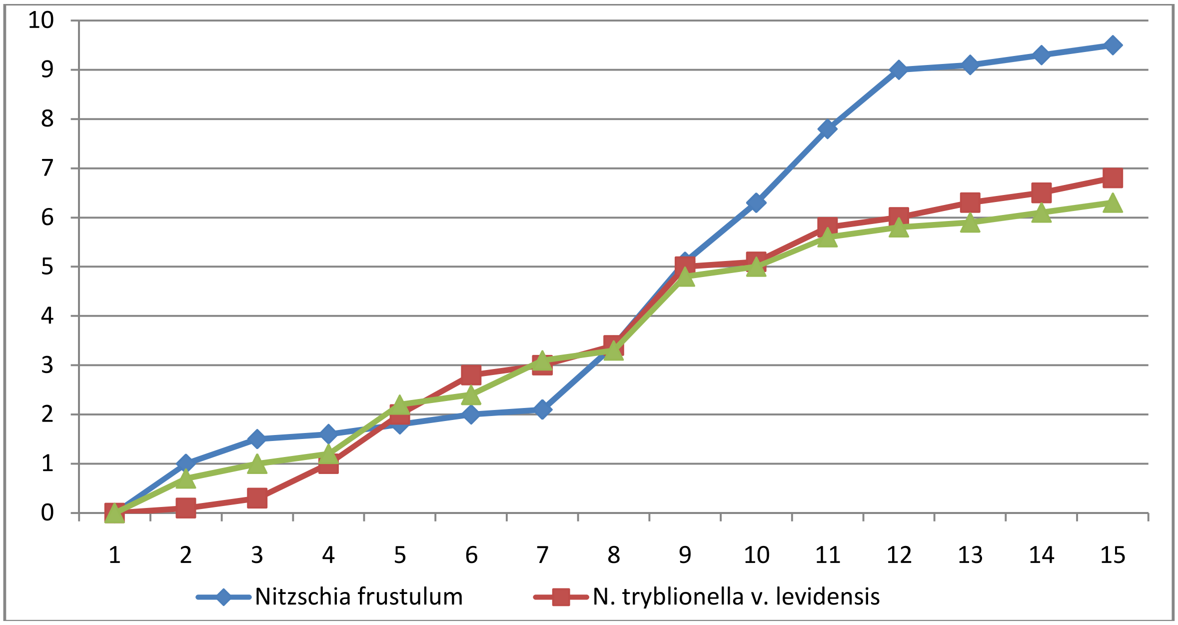

Figure-1
Growth of Microalgae

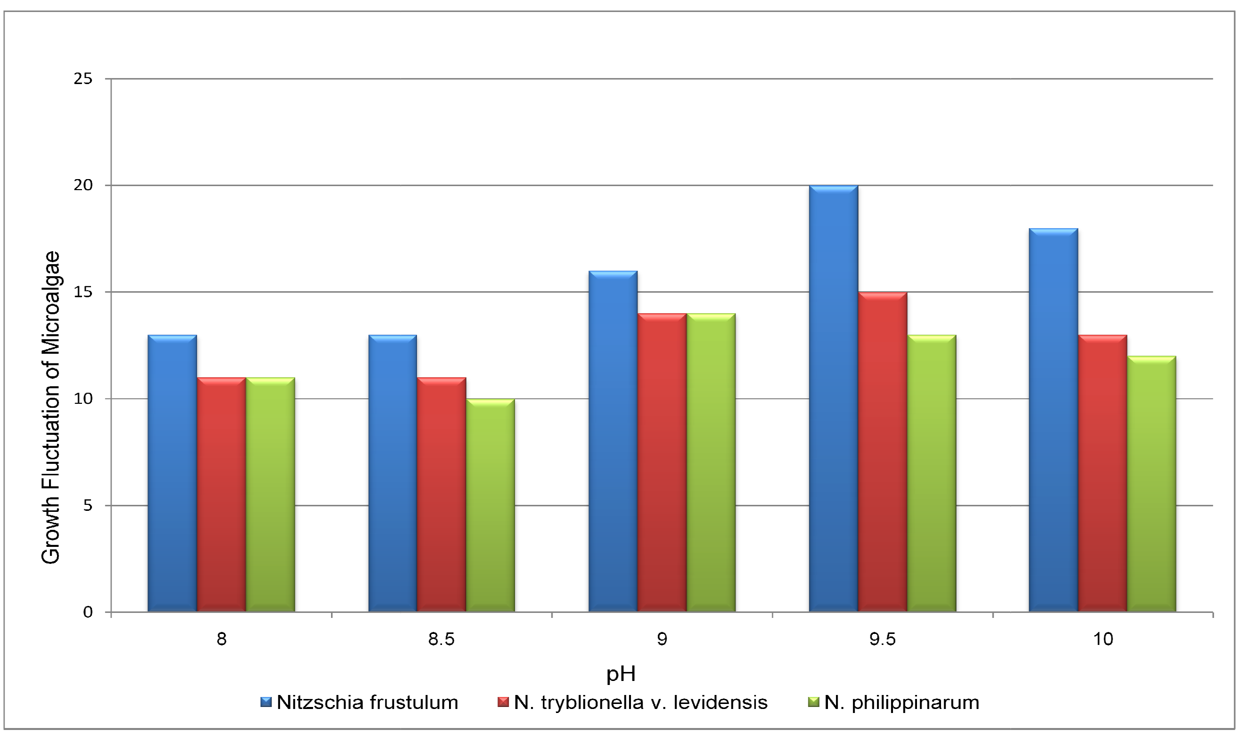

Figure-2
Growth Fluctuation of Microalgae with response to pH

Table-1
Biodiesel Production from Microalgae

Microalgae	Biomass g/l	Lipid Content %	Biodiesel Yield
Nitzschia frustulum	0.835 ± 0.010	40.13 ± 1.10	40.26 ± 2.10
N. tryblionella v. *levidensis*	0.457 ± 0.010	25.21 ± 1.10	27.00 ± 1.10
N. philippinarum	0.379 ± 0.010	24.34 ± 1.10	26.13 ± 1.10

Conclusion

As Compared to terrestrial crops which take a season to grow and oil-microalgae, grow quickly and contain high oil content. This is why microalgae are the focus in the algae-to-biofuels arena. Oil content of microalgae is usually between 20 and 50%, while some strains can reach as high as 80%. Hence, the present study was made on culture of three different microalgae, growth, flocculation activities, oil content and identification by using ASTM standards. The results obtained from this investigation revealed that *Nitzschia frustulum, N. tryblionella* v. *levidensis* and *N. philippinarum* were easy to cultivate which contains high lipid content. The faster growth rate as well as higher oil content found with these microalgae will make these as the potential candidate for alternative biodiesel production.

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