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Archives of Applied Science Research, 2012, 4 (2):795-799
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0975-508X
CODEN (USA) AASRC9

Microalgal resources in Chandrapur area, North-East, Assam, India: A perspective for Industrial refinement system and a boon for alternative energy generation and mitigation of green house gases

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ABSTRACT

Assam, North-East India is known for having a rich biodiversity of many rare and important medicinal plants species which makes it a biological hotspot. These rich and diverse bio-resources of the region are yet to be explored for their potential biotechnological applications. The seven sister states of North Eastern Region, more particularly Assam is rich in biodiversity of freshwater microalgae. Many microalgal species were reported for oil content in this region. A survey and algal sample collection was carried out at Chandrapur area Assam, some of the isolated microalgae strains were Chlorella sp, Selenastrum sp, Scenedesmus dimorphus, Scenedesmus quadricauda, Desmodesmus sp. etc. Out of which efficient oleaginous microalgae samples can be studied for biodiesel production their green house gases abatement potentiality.

Keywords: microalgae, lipid, flue gases.

INTRODUCTION

Carbon dioxide is regarded as the major atmospheric pollutant that contributes to green house effect. Biological CO_2 mitigation approaches have drawn much attention as they lead to production of biomass energy in the process of CO_2 fixation through photosynthesis. ([1-4]). Microalgae is a photosynthetic microorganism that is able to use solar energy to combine water with carbon dioxide to create biomass. As these cells grow in aqueous suspension, they have more efficient access to water, CO_2 and other nutrients [5]. They offer several advantages over higher plants, including their higher photosynthetic efficiency, higher growth rates and higher biomass production compared to energy crops ([4],[6],[7]). The search for an alternative source of fuel other than the diminishing fossil fuels has found a new vista in microalgae research. Algae can produce more oil per hectare than most other bio-fuel producing plants and Improved agricultural productivity using diverse science-based research can also improve the sustainability of biofuels by reducing competition for land [8]. In general, microalgae grow much faster than terrestrial plants, and the CO_2-fixation efficiency of microalgae is about 10–50 times faster than that of terrestrial plants [4],[10]. In addition, the organic matter produced by photosynthetic microalgae and cyanobacteria can be transformed into a wide range valuable products, such as biodiesel, food additives, health-care products, and so on [9], representing additional benefits from the microalgal CO_2 reduction process [3],[10].

The quest for Potential carbon dioxide mitigating species and a biodiesel Yielding Microalgae from Northeast India is a major target for most researchers dealing with generation and production of alternative fuels. The criteria for which algal strains are mainly selected and screened are on the basis of their growth rate, biomass productivity, lipid content and fatty acid composition. The Many strains have been identified so far from Assam and Meghalaya. The need of research involving the isolation and screening of freshwater microalgae of Assam in search of potential strains for high biomass and lipid production and to develop technology for mitigation of harmful green house gases is primary need of this region. Although many successful findings have been reported but are yet to be commercialized for sustainable development. The microalgal species found in Assam, North East India, has the promising potential for biotechnological application in increasing the bioactive output and initiating commercial exploitation in future (The Energy and Resources Institute; http://www.teriin.org)

MATERIALS AND METHODS

Researchers from North East Assam, is searching for potential bio-diesel-yielding strains as well as efficient algal strains to mitigate green house gases to combat against global climate change. For that purpose a survey was carried out in the Chandrapur area and samples were collected from its aquatic systems like ponds, lakes, rivers, Waste water from factories, wet lands, drainage systems from various industries etc. The rich biodiversity of Chandrapur, Assam, Northeast India has a good no of valuable algal species. It is situated at a distance of about 20 km from heart of the Guwahati city, Assam. The climate of this area is humid, sub-tropic. The average rainfall is 1250 mm . The average minimum and maximum air temperatures are 11.5^{o} C and 37^{o}C, respectively. The relative humidity is around 80%, (Data collected from website, community information centre, Chandrapur developmental block). We have collected waste water samples from drainage systems coming from these industries and presences of many microalgal strains were evidenced. Our investigations have indicated the existence of oil-generating microalgae Such as *Chlorella sp, Selenastrum sp, Scenedesmus dimorphus, Scenedesmus quadricauda, Desmodesmus sp*. etc. Further researches are going on to quantify the abundance of their occurrence.

Culture process

The isolated strains are being purified, identified, cultured and maintained in a suitable culture. Strains were purified by agar plating and subcultured by serial dilution method. BG11 culture media was selected and prepared for the growth of microalgae strains, fluorescent lamps were used as a source of light and intensity was adjusted to 2500~3500 lux for all the culture flasks and 16 hrs of light and 8 hrs of dark cycles were repeated for growth of all the cultures. The temperature was adjusted to 25.C for all the flasks. After attaining the maximum growth, the lipid content was determined gravimetrically by Bligh and Dyer method and expressed as dry weight %. [13].

Further researches will be carried out for their lipid classes which can be identified with the help of gas chromatography and mass spectroscopy, also stresses will be given to search and characterize an efficient microalgae strain for its tolerance to high concentration of industrial flue gases as well as to develop a technology to mitigate factory flue gases to reduce the amount of green house gases in the atmosphere. Many of these microalgal species can be rich sources of bio-fuel as well as they can be utilized for mitigation of carbon dioxide gases through application of suitable technology

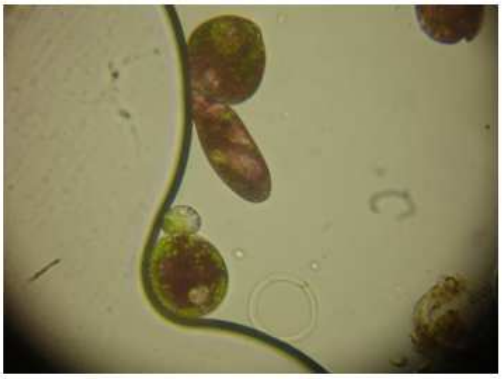
RESULTS

Analysis for growth rate and growth behavior of the samples and the impact of different environmental stressors and culture condition on growth, biomass, lipid accumulation and profile will be worked out in the Environmental Biotechnology laboratory, Department of Biotechnology, Gauhati University Assam. Figure-1 depicts the total lipid content of some of the isolated strains.

Chlorella sp. under 40X magnifiaction

Scenedesmus dimorphus under microscope(40X)

Scenedesmus quadricauda under 40X magnification



Euglena sp. under 40X magnifiaction

Selenastrum sp. under 40X magnifiaction

Microalgal oil extraction(lower layer)

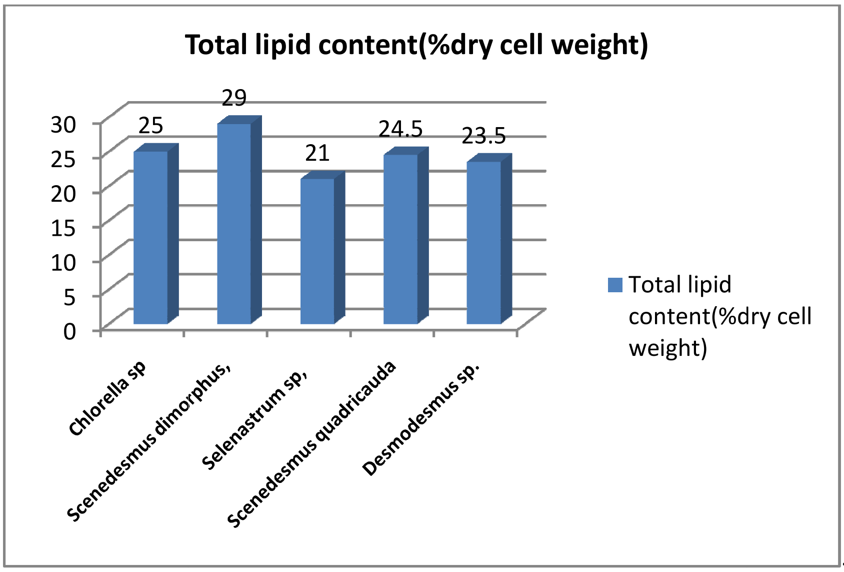


Figure 1: Total lipid content in terms of %dry cell weight of a few microalga strains. (Total lipid extraction by Bligh and Dyer method)

Natural habitates (ponds, lakes) are the major hotspots where huge microalgal diversity can be easily noticed. Microalgal samples for study were also collected from factory waste water and aquatic ponds near brick industries in Chandrapur area Assam.

CONCLUSION

Chandrapur has a rich microalgal diversity, but rapid urbanization and industrialization leading to a decrease in the wetlands and aquatic systems, as we found presence of many brick industries which are releasing poisonous flue gases continuously which is a major threat to environment as well as in ecological point of view. There is also presence of industries and factories that are releasing tons of wastes round the year to neighboring river streams. Most of the brick industries were surrounded by ponds, lakes and wetlands so efforts can be made to develope a suitable technology where open pond systems or raceway ponds can be developed scientifically for mass culture of microalgae in such a way that the industrial flue gases can be directly delivered to the pond system for feeding the microalgae cells for biomass production and by utilizing proper harvesting process to produce biofuel for sustainable energy development. This indicates an industrial refinement system where there is abatement of harmful green house gases and production of environmental friendly biofuel and this type of integrated efforts to cleanup industrial flue gas with wastewater treatment will significantly enhance the environmental and economical benefits of the technology for biofuel production by minimizing the additional cost of nutrients and savings of precious freshwater resources [12]. The merits of CO_2 bio-mitigation locates primarily in the fact that the biomass produced in the process of CO_2 fixation can be converted efficiently into biofuel [4]. Usage of fast growing oleaginous microalgal species could further enhance the feasibility of the technology.

In this regard we can easily come into a conclusion that a systemic survey and collection will lead to discovery of more microalgal and cyanobacterial strains in the Chandrapur area. We also expect that some of these will have substantial oil content that can be provided to algal repository and used for bio-diesel production at a commercial scale.

Acknowledgement
Authors are also thankful to Mr. Rituparna Borah for all his support and to Department of Science and Technology, India, for financial support .

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