# Cost Effective Environmental Friendly Sustainable Bio-Refinery Approach for Biofuel Production from Algae

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Depletion of fossil fuel sources is great global problem. Furthermore continued consumption of fossil fuels has created serious environmental consequences of Global warming due to increased release of Green House Gases. Bio-fuels are one of the potential options to reduce world dependence on fossil fuels but bio fuels have their limitations. The majority of current commercially available biofuels are produced from Sugar cane, Corn starch, and oil crops such as soy beans or rape seeds. Although bio fuels are environmental friendly than fossil fuels there is some dispute that whether these crop based bio fuels should be used in place of fossil fuels. To produce bio fuels from algae could be an alternative approach that does not have an impact on agriculture. Unicellular microalgae have been proposed for long time as a potential renewable fuel source (Benemann et al. 1977, Oswald & Gorule 1960). Microalgae are estimated to have higher biomass productivity in terms of land area required for cultivation and predicted to have lower cost per yield. Algal feed stock can be utilized directly or processed in to liquid biofuels and gas by variety of biochemical conversions or thermochemical processes (Amin 2009, Brennan & Owende 2010) Culturing of the microalgae as an alternative feedstock for the bio fuel production has received a lot of attention in the recent years due to their fast growth rate and ability to accumulate the high quantities of lipids and carbohydrates inside their cells for biodiesel and bio ethanol production. This superior feedstock offers several benefits such as effective land utilization, CO2 sequestration, when coupled with the waste water treatment, and it does not trigger the food v/s fuel feud. In the last decade, there is a heavy capital investment in the algae production industry. Because of many practical reasons like a failure in the implementation of lab technologies on-field and failure in making the processes economically affordable, the companies were forced to shut down. (Lam and Lee, 2011).

Algae are the excellent source of pigments like phycobiliproteins, carotenoids, polysaccharides, lipids, long-chain fatty acids and rich proteins. These products can be sold at higher prices compared to the biofuels, which could subsidise the price of biofuels and offset the higher cost of algal cultivation. This concept is known as the “Bio-refinery concept” (Bhowmick and Sen, 2018). This bio-refinery concept is a novel thing and is a boon to the algal production. Leu et al, used *Tetraselmis* for the sustainable biofuel production and value added products. They proposed that biomass that was cultivated per hectare with probable yield of 15 tonnes of ethanol which costs 7500 dollars it was on the contrary yielding 0.5 tons of the luetein which will cost 25, 0000 dollars.

The algal production can provide the environmental services like curbing the carbon dioxide emitted from the atmosphere or it can be used for bio-remediation of sewage water. As a green leap towards achieving energy and environmental sustainability (Bhowmick andSen, 2018), put forth the concept of zero waste algal bio-refinary for bio-energy. For cultivation they have used the flue gases and waste water for cultivation. (Bhowmick and Sen, (2018).

At KET"s V.G.Vaze College, Mumbai India, isolation of the various strains of the microalgae has been carried out from the saltpans of the Mulund, Mumbai areas. Amongst them, a microalgal strain identified as the Pseudanabena limnetica was shortlisted and the scaling up of the same strain was carried out from flask level to the 1000L flat panel photobioreactor. It was cultivated in the sea water based modified BG11 medium(MSW BG11To make the cultivation cost effective the photobioreactor system is operated in outdoor conditions and the strain could sustain higher temperatures from 35-40° C and high irradiance of 65,000-85,000 lux. ). (Magar and Deodhar 2018) To make the process environmental friendly, the reactor was operated in the premises of BioCNG station which produces 40% CO2 along with methane. The CO2 was sparged in Na2CO3 rich MSWBG11 medium and this CO2 enriched medium was used for continuous operation of photo bioreactor which yielded 54gms/L of biomass daily. To make the process economically viable, the bio refinery concept was followed. In the beginning the algal biomass was subjected to extraction of carotenoids which were further incorporated in sun screen cosmetic formulation. The remaining biomass was used in bio methane production. Unlike lignocellulosic biomass the algal biomass do not contain lignin and when co digested with cow dung in the ratio 1:1 brought about 8 times increase in Biogas production.