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Business, Strategy

The world witnessed industrial revolution since late eighteenth century till time fostered by developing technologies.

These developing technologies required tremendous energy fulfilled by mostly non-renewable sources. Introduction of fossil fuel gave a steady boost to industrial revolution owing to their applications in almost all sectors for energy. Fossil fuels are non-renewable source of energy formed due to chemical and biological reactions of biological masses buried deep down the earth surface millions of years ago. Fossil fuels mainly comprises of all the petroleum products and……. They are basically chain of carbon that on breaking release energy that drives a process. With the industrial revolution in last one and half century, use of machines has sky-rocketed. Eventually, increasing use of the fossil fuels at an exponential rate will eventually deplete their limited sources, causing a major energy catastrophe in near future. Shortage in a commodity causes it to become too expensive or too environmentally destructive to recover.

Also, it is now commonly known that use of fossil fuel contributes globally towards rise in the atmospheric CO2 and other harmful gases leading to adverse effects on the earth’s climate and atmosphere. These gases also contribute in principle to increase in global atmospheric temperature i. e global warming.

Hence, it has become essential to identify an alternative source of energy yielding faster productivity, at an economical rate, and yet environmentally friendly. Multiple sources of alternative energy are actively being sought to provide enough energy to suffice the needs of all the sectors leading to

become next player in the energy field. Popular among them are solar energy, hydrogen power, nuclear energy and biodiesel. Biodiesel as a source of energy has numerous traits that prove to be advantageous for use as fuel to replace traditional fossil fuels. These fuels are renewable, environment-friendly, biodegradable, and could be synthesized economically making it an important alternative to traditional fossil fuel.

Additionally, biodiesel possess chemical configuration similar to diesel fuel making it possible to be used without modifying existing engines. Further, it also reduces the net carbon dioxide emissions by 78%, sulphur emission by 98% and particulate matter by 50% as compared to conventional diesel fuel. 1, 2 Biodiesel can be essentially produced from all the biological sources. Production of biofuels from different such sources are sub-divided into multiple generations depending on the raw materials and route employed for production.

First generation biofuel utilize edible plant material like sugarcane, beetroots, maize etc. and non-food vegetable feedstocks e. g. lignocellulosic material are employed for production of second generation biofuel. However, these sources are often considered as unsustainable because of their competition with agricultural land and also it has no significant role in reducing green- house gas emissions.

4. Recently, a new strategy was devised for generation of biofuel using microalgae lipid as the source represented as third generation biofuel. Microalgae are photosynthetic microorganism that

uses only CO2 as a carbon source for their growth serving as a great auxiliary to reduce global atmospheric CO2.

Microalgae lipid based biodiesel production may occupy a projecting place as an energy generation source in near future in comparison to other sources based on edible plant material or lignocellulosic material representing a sustainable alternative to fossil fuels. 5 They can produce large amounts of triacylglycerides (TAGs) 25 as compared to vegetable oils providing some major advantages over commonly grown oleaginous plants such as palm, soy or rapeseed. Lipids produced by microalgae can easily be converted into an effective and clean fuel by transesterification for diesel engines.

It is also worth noticing that microalgae can be potentially grown year round non-arable land using sea water, waste water or employing hydroponics cultivation method, reducing the competition with arable land. Studies have proved that use of biodiesel instead of fossil fuel can also reduce risk of cancer by 95% and air toxicity by 90%. 6 There are approximately 26, 000 species of microalgae in the environment boasting one or other unique properties yet only a few strains have been identified and isolated for the successful commercial application. 7 Nonetheless, for successful and wider application of biofuel, it is very important to select few wild algal strain that can sustain efficient and robust photosynthesis while coping with large fluctuations in light intensity and quality, temperature, dissolved oxygen and CO2 concentrations, pH, evaporation, dilution rates.

The selected strains should be able in competing with adventitious algal species yet produce high percentage of lipid per gram biomass. Although

there are advances in genetic engineering technique, only a few significant advances in genetic manipulation of green microalgae have been achieved. Also, it is not advisable to go for genetic modification if the aim is to grow microalgae in open pond to get huge biomass. Thus, it is essential to identify some of the best lipid producer extremophilic microalgae strain from natural isolates. This can be achieved by comparing the flux profile of different strains of microalgae using isotopically non-stationary 13C Metabolic Flux Analysis (13C INST-MFA).

Also, some of the species of microalgae accumulate around 70% lipid of their dry cell weight when it is switched to different growth condition, however, a very little is known about the mechanism of lipid storage in microalgae7 and global changes in metabolism, such as degeneration of the chloroplast, redistribution of carbon flux, and reprogrammed nitrogen assimilation. So it is very important to decode the lipid accumulation mechanism in selected strains and find a culturing condition in lab, mimicking the environmental condition for maximal lipid production. Environmental photobioreactor (ePBR) is a growth column designed to replicates the environmental conditions for algae production in ponds and natural systems which impact algal physiology, energy capture, and life cycle. These photobioreactors are sufficiently small and provides high throughput analysis of algal strains under a matrix of conditions that will mimic the production conditions outdoor. The conditions are controlled with the help of the software and the data can be collected from the built-in or accessory sensors. Most microalgae only produce TAGs when cultivated under adverse growth conditions. Therefore, studies on TAG production in algae are usually done by arresting

the growth using for example nutrient deprivation after it has grown in optimal condition for sufficient biomass but many global changes in metabolism, such as degeneration of the chloroplast, redistribution of carbon flux, and reprogrammed nitrogen assimilation, remain poorly understood.

Often, these studies are not so much focused on the biological mechanism of TAG accumulation. Next challenge will be to reconstruct primary metabolic network of microalgae strain based on genome annotation and understand the mechanism of lipid accumulation in different cultivation condition that can be done with the help of metabolic flux analysis. So it is important to develop experimental and computational method of non-stationary 13C Metabolic Flux Analysis for microalgae.