

## A REVIEW ON IMPICATION OF THIRD GENERATION BIOFUEL AS A COST EFFECTIVE FUEL

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### ABSTRACT

Microalgae refer to a kind of autotrophic microorganism with rich nutrition and high photosynthetic utilization degree, which are widely living in the sea and land. Microalgae can be converted into bioenergy such as biogas, biodiesel and bio-oil. The current research and technology based on third-generation biofuels derived from algae biomass have been considered as the best alternative bioresource that avoids the disadvantages of first and second-generation biofuel. The main contribution of this work lies in the comparative study of algal feedstock with other biomass feedstocks, the advantages and disadvantages of microalgae are detailed. Since the large scale of microalgae bioenergy production has not been achieved yet, the commercial production requirements and the sustainability of microalgae are analyzed. As a result, high lipid content, less cultivated land use, and short lifetime circle are thought to be the typical advantages of microalgae that can be considered as a potential substitute for fossil fuel. This review discusses the importance of the algal cell contents, various strategies for product formation through various conversion technologies, and its future scope as energy security.

### I. INTRODUCTION

The world's energy demand is growing at an exponential rate. Only fossil fuels are used as a primary source of energy. As a result of the scarcity of fossil fuels, growing prices of petroleum-based fuels, energy conservation, and increased global warming, renewable energy sources such as solar, wind, hydro, tidal, and biomass have become increasingly popular around the world.

Biomass from a variety of sources, including agricultural, forestry, and aquatic, has been considered as a feedstock for the manufacture of biofuels such as biodiesel, bioethanol, biohydrogen, bio-oil, and biogas. However, the environmental impact of fuel combustion has a significant impact on the carbon cycle (carbon balance), which is linked to fossil fuel combustion. Furthermore, the exhaustion of various existing biomass without adequate compensation resulted in massive biomass scarcity, as well as rising environmental issues such as deforestation and biodiversity loss.

Recently, researchers and entrepreneurs have been particularly interested in algal biomass as an alternative feedstock for biofuel production. Furthermore, algal biomass is unaffected by agricultural food and feed production. Light, carbon dioxide, and certain nutrients (nitrogen, phosphorus, and potassium) are all that photosynthetic microorganisms like microalgae need to thrive and create enormous amounts of lipids and carbohydrates, which may then be converted into biofuels and other important co-products. Surprisingly, the low level of hemicelluloses and near-zero content of lignin in algal biomass leads to improved hydrolysis and/or fermentation efficiency. Algae has uses in human nutrition, animal feed, pollution control, biofertilizer, and waste water treatment, in addition to biofuels. As a result, the present review's goal is to investigate the potential of algae for the manufacture of various biofuels and to assess its potential as an alternative feedstock.

### II. LITERATURE SURVEY

Wang Yue et al concentrated on Microalgae allude to a sort of autotrophic microorganism with rich sustenance and high photosynthetic use degree, which are broadly living in the ocean and land. Microalgae can be changed over into bio energy, for example, biogas, biodiesel and bio oil. This theory presents an audit on the different development strategies and energy change methods of microalgae. Subsequently, high lipid content, less

developed land use and short life time circle are believed to be the common benefits of microalgae that it tends to be considered as an expected substitute of petroleum product.

Authors advanced done a few writing concentrate on exploring the possibility, unwavering quality and maintainability of microalgae as a sort of bioenergy feedstock, which can be broadly utilized in commercialization, was finished. The examination shows that microalgae as another biomass feedstock have likely advantage on the bioenergy creation. The high oil yields and less land use are the primary benefits of microalgae. [1]

Firoz Alam et al studied on "Biofuel from algae- Is it a viable alternative" checked on Petroleum product energy assets are draining quickly and above all the fluid non-renewable energy source will be lessened by the center of this century. What's more, the petroleum derivative is straightforwardly connected with air contamination, land and water corruption. In these conditions, biofuel from inexhaustible sources can be a choice to decrease our reliance on petroleum derivative and help to keep up with the solid worldwide climate and financial manageability. Creation of biofuel from food stock commonly devoured by people or creatures can be tricky and the underlying driver of overall disappointment. Biofuels creation from microalgae can give a few unmistakable benefits, for example, their fast development rate, ozone harming substance obsession capacity and high creation limit of lipids.

Firoz and different Creators assessed on Numerous nations including the European Association (EU) have embraced approaches on specific level of environmentally friendly power use for transport and other significant areas. In December 2008, the EU marked an order that requires 10% of part to come from inexhaustible sources (biofuels, hydrogen and green el strategy towards alleviation of environmental change impact and an Earth-wide temperature boost. The EU order additionally obliges the coalition to guarantee that biofuels offer somewhere around 35% fossil fuel byproduct investment funds contrasted with petroleum derivatives and the figure should ascend to half in 2017 and banter among states, policymakers, researchers and earthy people as right now most industrially delivered biofuels are gotten from sources that rival or have a place with feedstock for human and creature utilization. As far as ozone depleting substance outflow, the biofuels created from microalgae is by and large carbon nonpartisan. The CO<sub>2</sub> produced from consuming biofuel is thought to be unbiased as the carbon was removed from the climate when the green growth biomass developed. Along these lines, biofuels from microalgae don't add new carbon to the climate. Biofuels can be a suitable option in contrast to petroleum derivatives based on short and medium conditions. Furthermore, progressed biofuels produced using deposits or waste can possibly diminish CO<sub>2</sub> emanations with 90% contrasted with petroleum/diesel.[2]

Saurabh Singh et al studied on "Research and Production of Third-Generation Biofuels" and inspected term biofuel has turned into a popular expression inferable from the benefits that it addresses in the current world situation. We are entrusted with sorting out answers for barometrical contamination and environment sway from ozone depleting substance outflows - essentially, oxides of nitrogen and carbon because of the consuming of petroleum products. Biofuels can altogether lessen the quantity of ozone harming substances going into the climate. Biofuels have additionally been sorted into various classifications in view of the kind of feedstock utilized for the readiness of the biofuel. Until now, there have been four arrangements of biofuels. Original biofuel, is the place where the substrate utilized is serious in nature with the food crops. Second-age biofuel is predominantly created from the waste material from ranches. Third-age biofuels are created from green growth. Fourth-age biofuels utilize the method of carbon catch from the environment for the development of biofuels. Additionally, there is a higher benefit related with each succeeding age of biofuel. With each progressive age of biofuel, the quantity of net emanations into the environment falls. For instance, the third era of biofuels is called zero-emanation advancements, though the fourth era of biofuels is called negative-outflow innovations, attributable to their net negative discharges into the climate. Biofuels can be delivered from various farming substrates, yet the creation amounts in the algal biofuels are a lot higher. This makes the innovation essentially better in contrast with first and second era, attributable to their territory region prerequisites.[3]

Firoz Alam et al studied on "Third generation biofuel from Algae" and afterward examined on the utilization of fluid petroleum derivative as an energy source has for quite some time been viewed as unreasonable and above

all the fluid petroleum product will be reduced by the center of this century. Furthermore, the petroleum derivative is straightforwardly connected with natural corruption and nursery outflow. Biofuel delivered from plants, creatures or green growth items can offer a choice to decrease our reliance on petroleum product and help to keep up with sound worldwide climate. Miniature green growth is becoming famous contender for biofuel creation because of their high lipid substance, simplicity of development and fast development rate.

Firoz and other authors explored about Biofuel offers a genuine enhancement to fossil on the off chance that high yielding green growth species can be distinguished, progressed creation and collecting strategies are utilized, and inventive drying and oil extraction processes are used. Given the present status of-craftsmanship, the biofuel can't be a full substitution of non-renewable energy source in short-term.[4]

Brenda J. Álvarez-Chávez et al studied on "Optimization of microwave-assisted hydrothermal pretreatment and its effect on pyrolytic oil quality obtained by anaerobic reactor" and reviewed that Microwave-helped aqueous (MHT) treatment of biomass has gotten huge consideration attributable to energy productivity during inner energy move and the extra advantages to the hydrochar delivered concerning physicochemical organization. Thusly, this study proposes the mix of MHT pretreatment with the quick pyrolysis process, to assess and improve the impact of this treatment on the nature of the hydrochar and, therefore, on the nature of the bio-oil. The improvement of MHT treatment utilizing dark tidy was completed, trailed by quick pyrolysis of the hydrochar created under ideal circumstances in a drill reactor at 550 °C to get an excellent bio-oil. Accordingly, the pretreated biomass displayed from one viewpoint a huge lessening in the debris content by % in the substance of the extractives. While then again, the acquired hydrochar showed an expansion in the accessibility of cellulose by % as a result of the decrease in the substance of hemicellulose. As needs be, hydrochar showed an expansion in warm solidness during pyrolysis and it created a higher absolute bio-oil yield.

Brenda et al and Authors explored that The impact of temperature, time, and biomass-water proportion in the MHT pretreatment was assessed and afterward it was improved through reaction surface strategy as an overhauling method to the biomass before quick pyrolysis. Hydrochar attributes demonstrates that MHT can decrease the debris content and hemicellulose which was both advanced by the expand of temperature. The ideal hydrochar created showed a higher warm soundness because of the separation of acetyl gatherings, present in hemicellulose[5]

Shuvashish Behera Et al studied on "Scope of algae as third generation biofuels" and gone research through numerous and innovation in light of the third era biofuels got from algal biomass have been considered as the best option bioresource that evades the drawbacks of first and second era biofuels. Algal biomass has been explored for the execution of financial change processes delivering different biofuels, for example, biodiesel, bioethanol, biogas, biohydrogen, and other important co-items. In the current audit, the new discoveries and advance improvements in algal biomass for improved biofuel creation have been investigated.

Moreover shvashish and Authors inspected on the observing different elective assets, which can supplant petroleum derivatives. Because of presence of a few benefits in algal biofuels like marsh necessity for biomass creation and high oil happy with high usefulness, it has been considered as the best asset, which can supplant the fluid oil fuel. Nonetheless, one of its bottlenecks is the low biomass creation, which is a hindrance for modern creation. Additionally, another drawback incorporates gathering of biomass, which has high energy inputs. For a monetary cycle advancement in contrast with others, a practical and energy effective gathering techniques are expected with low energy input. Consequently, utilization of the standard algal gathering procedure, biorefinery idea, progresses in photobioreactor plan and other downstream innovations will additionally diminish the expense of algal biofuel creation, which will be a serious asset soon.[6]

Edgar G Hertwich Et al studied on "Concentrating Solar Biomass Gasification Process for a 3rd Generation Biofuel" what's more, considered on another idea of creating synfuel from biomass utilizing concentrating sun oriented energy as its fundamental energy source is proposed in this paper. The point of the idea is to acquire a simple to deal with fuel with almost zero CO<sub>2</sub> discharge and decreased land-use prerequisites contrasted with first and second era biofuels. The idea's key component is the utilization of high temperature heat from a sunlight based thinking pinnacle to drive the compound course of changing biomass over to a biofuel, getting a close total use of carbon particles in the biomass. H<sub>2</sub> from water electrolysis with sun based power is utilized

for turn around water gas shift to abstain from creating CO<sub>2</sub> during the interaction. In a synthetic interaction reenactment, we contrast the sunlight based biofuel idea and two other progressed synfuel ideas: second era biofuel and coal-to-fluid, both utilizing gasification innovation and catch and capacity of CO<sub>2</sub> created in the fuel creation. The sun powered driventhird age biofuel requires just percent of the biomass input and percent of complete land as the second era biofuel, while as yet showing a CO<sub>2</sub>-unbiased fuel cycle. With CO<sub>2</sub> catch, second era biofuel would prompt the evacuation of half of the carbon in the biomass from the environment. There is a compromise between marked down biomass feed costs and the expanded capital prerequisites for the sun based driven process; it is alluring at middle biomass and CO<sub>2</sub> costs.[7]

Milledge JJ Etal studied on "A review of the harvesting of micro-algae for biofuel production" examined and checked on that algal biomass is 'energy rich', the development of green growth in weaken suspension. Most work on miniature algal species determination for biofuel creation has been centered around yield and piece instead of on simplicity of recuperation.

Milledge and creators explored on the sedimentation and flocculation possibly give the most reduced energy input for miniature algal reaping, however there gives off an impression of being nobody technique or blend of gathering strategies fit to all miniature green growth. The convergence of the microalgae from the different reaping strategies can shift from lower to medium percentage of dry weight, and further dewatering or drying might be expected preceding energy extraction from the miniature green growth. The level of fixation required will differ with the strategy used to deliver useable energy from the miniature green growth. The most energy-proficient technique for reaping or of creating

useable energy from miniature green growth may not be important for the most by and large energy effective miniature algal biofuel creation process. The most energy productive miniature algal biofuel cycle could comprise of a development framework that doesn't give the greatest yield, however brings about an all the more effortlessly collected miniature algal biomass, and an energy extraction process that requires the base focus by the miniature algal reaping technique. Assuming effective gathering is, as numerous analysts consider, the significant test of commercializing miniature algal biofuel it will affect the plan and activity of both upstream and downstream cycles in an in general miniature algal biofuel creation process.[ 8]

Thangavel Mathimania and etal studied on "Utilization of algae for biofuel, bio products and bio-remediation" also, contemplated on Algae and it is are considered as a promising hotspot for biofuel and bio-items. Green growth contain sugars, lipids, proteins and their photosynthetic and lipid gathering potential makes them a reasonable possibility for bioenergy. Algal biomass is utilized in the creation of biofuels like biodiesel, bioethanol, biobutanol, and biohydrogen and so forth Consequently, this audit gives an outline on the use of algal biomass in different applications like fuel, food and climate.

Thangavel and Authors looked into on the commercialization of microalgal biodiesel is conceivable by laying out savvy techniques for extraction and creation. Aside from their job in bioenergy creation, green growth have additionally been utilized in bioremediation of waste water, expulsion of poisonous weighty metals, pesticides and CO<sub>2</sub> sequestration. Fundamental utilization of green growth to create biomass for esteem added items will advance the foundation of biorefinery approach.. Microalgal species can likewise utilize supplement from squander water and stay proficiently, along these lines utilization of significant expense natural substances or synthetic as supplements can be handily supplanted, which will likewise lessen the expense of creation. This approach would give a much feasible, cleaner, ecofriendly and energy effective innovation for biodiesel creation. Yet, the commercialization of microalgal biodiesel is conceivable by laying out practical strategies for extraction and creation. Aside from their part in bioenergy creation, green growth have additionally been utilized in bioremediation of waste water, expulsion of harmful weighty metals, pesticides and CO<sub>2</sub> sequestration. Foundational utilization of green growth to create biomass for esteem added items will advance the foundation of biorefinery approach.[ 9]

Jyoti Prakash Maity and Etal studied on "Microalgae for third generation biofuel production, mitigation of greenhouse gas emissions and wastewater treatment". And studid on Present and future points of view". What's more, reserached on broad utilization of petroleum products is progressively perceived as unreasonable as an outcome of consumption of provisions and the commitment of these energizes to environmental change by GHG (ozone harming substance) emanations into the climate. Microalgae show



elective inexhaustible manageable energy sources as they have a high potential for creating a lot of biomass which thusly can be utilized for creation of various third-age biofuels at large scale. Microalgae change the sunlight based energy into the carbon stockpiling items, prompts lipid aggregation, including TAG (triacylglycerols), which then can be changed into biodiesel, bioethanol and biomethanol.

The accumulation of target bioenergy carrier's strains as microalgae provides a beneficial prospective for oil, biodiesel, ethanol, methanol, biogas production, wastewater treatment and GHG mitigation. Microalgal feedstock use for biofuel production reduces the cultivation area (per ha) when compared to compared to the feedstock production of first and second generation biofuel. TAGs (triacylglycerols) is a storage lipid that is produced in photosynthetic microalgae by fixing the CO<sub>2</sub> in presence of photon energy. [ 10]

Yonghua Li-Beissona and Gilles Peltier studied on "Third-generation biofuels: current and future research on microalgal lipid biotechnology ". also, evaluated on that One major problem looked by current cultures is to foster sustainable power for transportation. Microalgal biomass offers an alluring arrangement because of its high (yearly) surface biomass usefulness, proficient transformation of sun powered energy into compound energy and the capacity to develop on non-farming area. Notwithstanding these extensive benefits, microalgal biofuels are not yet industrially economical. Significant difficulties lie in further developing both development advancements and microalgal strains. A microalgal crop animal groups is yet to arise. Conceivable future exploration headings to increment oil yields in microalgae are additionally featured.

Authors checked on the Photosynthetic microalgae have furnished us with food and feed, and presently perhaps at the same time fuel. Research on microalgae lipids have made some amazing progress beginning from the 40's during the Second World War in Germany. Given the high effect of exploration on energy, algal fuel advancement is firmly connected with financial, social and world turn of events. Advances grew today have advanced from control of a couple of qualities to more framework based approaches. These innovations incorporate high-throughput genome sequencing, and a suit of - omics advancements (genomics, transcriptomics, proteomics, metabolomics, and lipidomics). These amazing assets whenever utilized along with change and sub-atomic hereditary tool stash created for specific algal strains give sufficient chances to lipid researchers to upgrade algal digestion toward creation of oils or other synthetic particles helpful for modern applications[11]

M.V. Rodionova and etal studied on "Biofuel production: Challenges and opportunities" also, looked into on that It is expanding clear that biofuels can be a reasonable wellspring of environmentally friendly power as opposed to the limited nature, international shakiness, and injurious worldwide impacts of petroleum derivative energy. Altogether, biofuels incorporate any energy-improved synthetics created straightforwardly through the natural cycles or got from the compound transformation from biomass of earlier living organic entities. Overwhelmingly, biofuels are created from photosynthetic creatures like photosynthetic microorganisms, miniature and large scale green growth and vascular land plants. The essential results of biofuel might be in a gas, fluid, or strong structure. These items can be additionally changed over by biochemical, physical, and thermochemical techniques. The third era is the biofuels created from cyanobacterial, microalgae and different microorganisms, which is the most encouraging way to deal with fulfill the worldwide energy needs.

R A Volosin and different Authors concentrated on that While the worldwide energy request is expanding, fossil energy has the proceeding with shortcomings with the huge gamble to climate. How much fuel universally consumed as well as the interest is relied upon to develop quickly, and the utilization of fossil energy makes critical issue and unsafe effect the climate on earthCurrently it is as yet hazardous and trying for biofuel to be monetarily aggressive over petroleum derivative. In light of current advancement and advances in the field of biofuel creation, we trust that the enormous scope creation of biofuels is earnest and feasible to meet our energy need from here on out[12]

Stuart A Scott<sup>1</sup> and Etal studied on "Biodiesel from algae: challenges and prospects". Furthermore, reviwed on that A Microalgae offer incredible potential for double-dealing, including the development of biodiesel, yet the interaction is still some way from being carbon unbiased or industrially suitable. A contributor to the issue is that there is minimal laid out foundation information nearby. We ought to look both to accomplish gradual advances and to expand our key comprehension of green growth to recognize potential outlook changes. In doing this, joining of science and designing will be fundamental. In this audit we present an outline of a

potential algal biofuel pipeline, and spotlight on ongoing work that handles advancement of algal biomass creation and the substance of fuel particles inside the algal cell.

Stuart and different Authors investigated on undoubted potential presented by algal biodiesel. Without cautious evaluation of the energy adjusts and ecological effects, there is a risk that many proposed plans would be illogical according to the perspective of maintainability. Additionally the absence of information from genuine shows implies that financial evaluations are basically speculative, and there is a squeezing need to lead pilot learns at a reasonable scale and under winning atmospheric conditions, to survey productivities prone to be accomplished by and by. Notwithstanding, it has been accounted for that the freshwater green microalga *Parietochloris incisa* improves not exclusively its TAG creation under N starvation yet additionally the extent of arachidonic corrosive, a significant nutraceutical. For this situation, the significant result could make biodiesel creation from this species reasonable. Accordingly laying out the plausibility of algal biofuel creation paying little heed to energy input, will be a significant stage in giving the stage to streamlining, and furthermore for laying out promising lines for future research.[13]

Roman A. Voloshin et al studied on "Biofuels are the promising alternative to exhaustible, environmentally unsafe fossil fuels". And studied on Algal biomass is appealing crude for biofuel creation. Its development doesn't go after cropland with farming developing of food crop for biofuel and doesn't need complex treatment techniques in examination with lignocellulose-improved biomass. Numerous microalgae are mixotrophs, so they can be utilized as energy source and as sewage purifier all the while. One of the principle ventures for algal biofuel creation is the development of biomass. Photobioreactors and outdoors frameworks are utilized for this reason. The formers permit the cautious development control, yet the last ones are less expensive and less difficult. Biomass transformation cycles might be isolated to the thermochemical, substance, biochemical techniques and direct burning. For biodiesel creation, fatty substance enhanced biomass goes through transesterification. For bioalcohol creation, biomass is exposed to maturation. There are three techniques for biohydrogen creation in the microalgal cells: direct biophotolysis, backhanded biophotolysis, maturation.

Roman and other authors reviewed on work been completed to work on the adequacy and effectiveness of cycles of biofuel creation from green growth biomass. The third era biofuel should be without downsides of the initial two generations]. Large numbers of the works are pointed toward improving of green growth development framework: outside framework and photobioreactor. The third era biofuel isn't serious in the energy market for the time being. It is at the improvement stage. Algal biomass has not yet turned into a famous natural substance for the age of motor powers, despite the fact that there are numerous concentrated bioreactors. Green growth stand out as energy source, yet was a wellspring of various pharmacological and cosmetically huge mixtures. The absence of systems for modest development blocks commercialization of third era biofuel. The way that an enormous number of assorted works is completed in this space demonstrates that at present algal energy is seriously creating every which way: expansion in development rate, improving of gathering techniques, the hereditary designing of harvests, advancement of synthetic and warm strategies for delivering biofuels. This is because of the direness of the energy issue: the ecological dangers are related with the utilization of petroleum products and impediments of first and second era biofuels. However, a ton of work on improving of green growth development and handling components should be done to guarantee commercialization of microalgal biofuels. All things considered, we can expect that in the future biofuels can satisfy the needs for energy. It will be eco-accommodating and minimal expense arrangement of energy issues[14].

### III. CONCLUSION

This literature study on researching the feasibility, reliability and sustainability of microalgae as a kind of bioenergy feedstock, which can be widely used in commercialization, was done. The analysis shows that microalgae as a new biomass feedstock have potential benefit on the bioenergy production. The high oil yields and less land use are the main advantages of microalgae. However, to achieve large-scale industrial production, many difficult problems have to be solved and improved. Microalgae production is a complex engineering system, in which a multi-disciplinary, multi-field and huge investment cost are necessarily involved. Currently, the large sets of technologies are lacking, large-scale production is not implemented yet and production costs are much higher than petroleum oil. Some technique problems such as microalgae species selection, the

harvesting, concentrated microalgae, microalgae cell wall breaking and oil extraction must be improved. Solving those production technique problems, at the same time, reducing equipment investment costs and production. costs are considered as the more difficult challenges. The microalgae cultivation is the base of biofuel development, genetic engineering has to be developed in order to break through the microalgae oil content problem and growth rate problem to establish a new sustainable renewable energy.

Algae energy development is not only needed to breakthrough in technical issues, but also to reduce costs in production process. Only in this way, the microalgae energy will have more advantages compared with petroleum. The reason why today's society strongly advocates to the development of new energy is not only to consider the environmental protection problems, but there are also strategic considerations. Conflicts connected to existence of petroleum crude oil in the Middle East region, have been several (Gulf War and twice The IraqWar).. Recently, many countries (such as Japan, China, The U.S., Russia, and Southeast Asia countries etc.) have began to the successively develop undersea energy, and that resulting with oceans disputes (South China sea dispute between China and Philippines, The diaoyu Islands dispute between China and Japan, and Four Northern Islands dispute between Japan and Russia) emerging and intensified around the world. (Chinese Academy of Social Sciences, 2009) The emergence of home-made new energy can help us get rid of these problems. Microalgae do not need to occupy the land and can be sewage farmed. These characteristics of algae are the facts encouraging us to have domestic self-production in the almost every country. So that imports dependence on petroleum oil can be greatly reduced, thereby reducing the chances of resource plundering war in the world.

Undeniably, algae energy has some bottleneck problems that remain to be studied. Due to the absence of large-scale production, the levels of environmental impacts of microalgae production are still unknown. But microalgae have ability to help us alleviate the food crisis, oil shortage problems, and to avoid some of the wars and disputes which happened by energy resources. As technology continues to be progressed and algae production industrialization continues to be improved, microalgae energy as the third generation biofuel will contribute their own strength to relieve the tense situation of resources.

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