International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 3 May-June 2024, pp: 902-914 www.ijprajournal.com ISSN: 2456-4494

Study of Algae and Production of Biodieselfrom Algae

Mr.Shelke Chaitanya Jalindar, Ms.Vijaya Arjun Kute, Dr.Vijay Dhondiram Wagh, Mr.Vikas Kailas Ighe

Student,Nashik Gramin Shikshan Prasark Mandal's College Of Pharmacy Anjaneri, Nashik.
Professor,Nashik Gramin Shikshan Prasark Mandal's College Of Pharmacy Anjaneri, Nashik.
Principal,Nashik Gramin Shikshan Prasark Mandal's College Of Pharmacy Anjaneri, Nashik.
Student,Nashik Gramin Shikshan Prasark Mandal's College Of Pharmacy Anjaneri, Nashik.

Date of Submission: 10-05-2024 Date of Acceptance: 20-05-2024

ABSTRACT

Microalgae have recently attracted considerable interest worldwide, due to their extensive application potential in the renewable energy, biopharmaceutical, and nutraceutical industries. Microalgae are renewable, sustainable, and economical sources of biofuels, bioactive medicinal products, and food ingredients.Because it is derived from renewable resources and has positive effects on the environment, biodiesel has gained popularity recently. The primary obstacle to the product's commercialization, however, is the expense of biodiesel. The main strategies to be taken into consideration to reduce the cost of biodiesel are the utilisation of spent cooking oils as raw material, adaptation of a continuous transesterication process, and recovery of high grade glycerol from biodiesel by-product (glycerol).

One of the greatest challenges of the 21st century is to obtain an ecological source of transport fuels. The production of biofuels based on feedstock obtained through the exploitation of arable land translates into an increase in food prices and progressive degradation of the environment.Unlike traditional agricultural raw materials, algae are a neutral alternative in many respects. They can even be obtained as waste from polluted water reservoirs. One of the manifestations of the deterioration of surface waters is the eutrophication of water reservoirs, which leads to an increase in the number of algae. Algae reaching the shores of water reservoirs can be used as a raw materialfor the production of biofuels, including biogas, bioethanol and biodiesel.

Key Word: Microalgae , renewable energy , biodiesel , bioethanol , Biogas.

I. INTRODUCTION OF MICROALGAE.

Algae are a group of unicellular and multicellular organisms defined using morphological and ecological criteria and belong to the key producers in aquatic environments.[1,2]Renewable biofuels are needed to displace petroleum-derived transport fuels, which contribute to global warming and are of limited availability. Biodiesel as well as bioethanol are the two potential renewable fuels that have attracted the most attention. As demonstrated here, biodiesel and bioethanol produced from agricultural crops using existing methods cannot sustainably replace fossil-based transport fuels, but there is an alternative. Biodiesel from microalgae seems to be the only renewable biofuel that has the potential to completely displace petroleum-derived transport fuels without adversely affecting supply offood and other crop products.[3]Biodiesel, an alternative diesel fuel, is made from renewable biological sources such as vegetable oils andanimal fats. It is biodegradable and nontoxic, has lowemission proles and so is environmentally benecial[4]

The biodiesel produced from algal oil has physical and chemical properties similar to dieselfrom petroleum, to biodiesel produced from crops of 1st generation and compares favorably with the International Biodiesel Standard for Vehicle[5] The nutrients for the cultivation of microalgae (mainly nitrogen and phosphorus) can be obtained from liquid effluent wastewater; therefore, besides providing its growth environment, there is the potential possibility of waste effluents treatment[6] Algae are broadly classifed as Rhodophyta (red algae), Phaeophyta (brown algae), and Chlorophyta (green algae) and classifed by size as macroalgae or microalgae. Macroalgae (seaweed) are multicellular, large-size algae, visible with the nacked eye, while microalgae are microscopic single cells and may be prokaryotic, similar to cyanobacteria (Chloroxybacteria), or eukaryotic, similar to green algae (Chlorophyta).Microalgae can be a rich source of carbon compounds, which can be utilized

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 3 May-June 2024, pp: 902-914 www.ijprajournal.com ISSN: 2456-4494

in biofuels, health supplements, pharmaceuticals, and cosmetic[7]

The mechanism of photosynthesis in microalgae is similar to higher plants, with the difference that the conversion of solar energy is generally more efficient because of their simplified cellular structure and more efficient access to water, CO2, and other nutrients. For these reasons, microalgae are capable of producing 30 times as much oil per unit of land area compared to terrestrial oilseed In microalgae cultivation, carbon dioxide is fed constantly during daylight hours. Algae biodiesel production can potentially use some of the CO2 that is released in power plants by burning fossil fuels. Ideally, microalgal biodiesel would be carbon neutral, as all the power needed for producing and processing the algae would come from biodiesel itself and from methane produced by anaerobic digestion of biomass residue left behind after the oils have been extracted. The production of biofuel from microalgae has gained considerable attention due to the fact that they can be converted into several different types of renewable biofuels such as green diesel, jet fuel, methane biogas, ethanol, and butano[8]

1)BIODIESEL RESOURCES:

Crop	Oil Yield(L/ha)
Corn	172
Soyabean	446
Canola	1190
Jatropha	1892
Coconu	2689
Oil palm	5950
Microalga	136900

Table 1. Comparison Of Some Sources Of Biodiesel [9]

1)ALGAE:

"Alga is a term that describes a large and incredibly diverse group of eukaryotic, photosynthetic lifeforms. These organisms do not share a common ancestor and hence, are not related to each other (polyphyletic)."[10]

FIG 1.ALGAE[11]

❖ **CHARACTERSTICS OF ALGAE:**

- Algae are photosynthetic organisms
- Algae can be either unicellular or multicellular organisms
- Algae lack a well-defined body, so, structures like roots, stems or leaves are absent
- Algaes are found where there is adequate moisture.
- Reproduction in algae occurs in both asexual and sexual forms. Asexual reproduction occurs by spore formation.
- Algae are free-living, although some can form a symbiotic relationship with other organisms.[10]

II. TYPE OF ALGAE.

1)Green Algae:

One lineage, the chlorophyte algae or Chlorophyta sensu stricto, comprises most of what are commonly called green algae and includes most members of the grade of putatively ancestral scaly flagellates in Prasinophyceae plus members of Ulvophyceae, Trebouxiophyceae, and Chlorophyceae[12]

Figure No 2 .Green Algae[13]

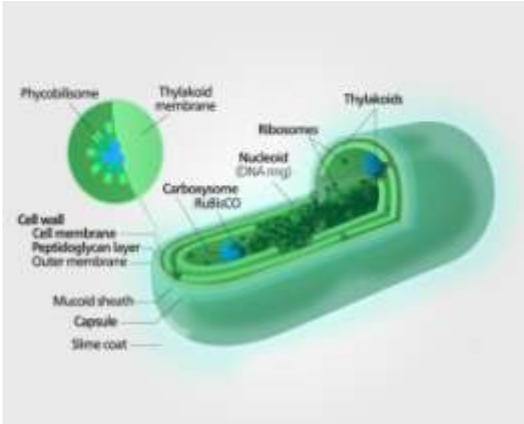
International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 3 May-June 2024, pp: 902-914 www.ijprajournal.com ISSN: 2456-4494

2)Red Algae:

The Rhodophyta comprises one of the largest phyla of algae, containing over 7,000 currently recognized species with taxonomic revisions ongoing.[14] Red algae are abundant in marine habitats but relatively rare in freshwaters.[15] The red algae form a distinct group characterized by having eukaryotic cells without flagella and centrioles, chloroplasts that lack external.endoplasmic reticulum and contain unstacked (stroma) thylakoids, and use phycobiliproteins as accessory pigments, which give them their red color.[16]

Figure No 3. Red Algae[17]

III. INTERNAL STUCTURE OF MICROALGAE.[18]



IV. MICROALGAE AND THEIR PRODUCT.

due to their high capacity to produce and accumulate various macromolecules (proteins, carbohydrates, and lipids) with several uses in the food and feed industry, and more recently, as a source of biodiseal.[19,20)] microalgae are a very important source of several high-added value products such as pigments, PUFAs (poly-unsaturated fatty acids), peptides, exo-polysaccharides, among others, with a clear benefit to human health and nutrition .[(21,22)]

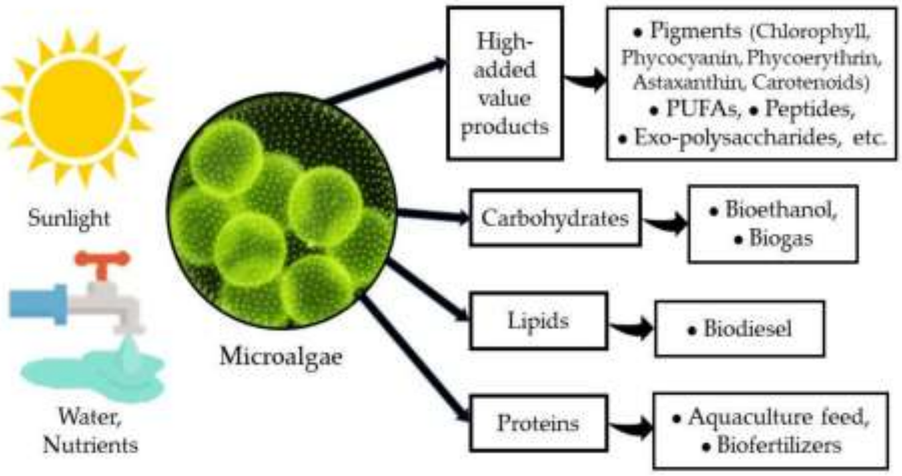


Figure No 4. Microalgae And Their Product[23]

V. FACTORS INVOLVED IN THE GROWTH OF MICROALGAE.

To grow, microalgae have many needs; the most important physical factors are a source of energy, usually light and an optimum temperature. There are also the chemical factors which are the available concentration of carbon dioxide and the contribution of macronutrient and trace elements.

Algal growth is affected by several parameters such as mixture and oxygen concentration

- **Light:**

Light is the most important factor for the photosynthetic growth of algae. It has an effect on the cellular composition of microalgae (photoadaptation or photoacclimatation)[24].

Compensation intensity (Ic) is the value of the luminous intensity before which there is no photosynthesis activity. Only cellular respiration activity is present. The intensity of compensation is the intensity where the photosynthesis just compensates for the respiration. The luminous intensity of saturation (Is) is the intensity where the efficacy of photosynthesis (or photosynthesis rate) is maximal (photolimitation). The luminous intensity of inhibition (Ipi) is the intensity or activity of photosynthesis is inhibited by light. According to Barbosa et al., the photoinhibition becomes pronounced for a luminous intensity greater than 1200 μmol · m−2 · s−1.[25]

- **Tempreture:**

Temperature is one of the most important physical factors influencing the growth of microalgae. For each temperature there is a specific luminous intensity to achieve the maximum photosynthesis rate. The optimum temperature increases therefore with the increase of the luminous intensity. There is also an optimum temperature for maximum biomass production, but the temperature variation also acts on the cell composition. The decrease in temperature increases the degree of lipid unsaturation and the increase in temperature results in increased concentrations of the pigments but also an increase in the concentration of oxygen radicals. If microalgae do not grow at optimum temperature, the need for carbon and nutrients to achieve the same growth rate is more important .[26]

- **Ph:**

The pH of the culture medium is one of the important factors in algal cultivation. pH of medium for algae growth is usually neutral or slightly acidic, mainly to avoid precipitation of several major elements. The algae exhibit a clear dependency on pH of the growth medium and different species vary greatly in their response to Ph[27]

- **Neutrients:**

Nutrients are inorganic or organic compounds other than carbon dioxide and water, used for growth whose presence in the cell is necessary for cellular function. Some algae require specific organic compounds synthesized by other organisms. However, many algae require only inorganic nutrients, and it is likely that these algae could be used as feedstock for biomass fuel production. Limiting nutrients to algae are nitrogen, phosphorus, silica (for diatoms) and iron .[28]

- **Mixing:**

Mixing and aerating provide uniform distribution of nutrients, air, and CO2 in microalgae culture. They also enable the penetration and uniform distribution of light inside the culture and prevent the biomass from settling and causing aggregation[49].

If all the other requirements are met but there is no mixing, biomass productivity will be lowered signifcantly. Tus, microalgae cultures must be continuously mixed to keep all cells in suspension with free access to light. A proper mixing system in a photo-bioreactor not only enables nutrient dissolution and light penetration into the culture but also provides for efcient gaseous exchange[50].

- **Algae Have Numerous Advantages Over Terrestrial Plants:**

- They use solar energy with efficiencies 10 times higher compared with terrestrial plants, fixing higher quantities of CO2.
- 2. They can grow in fresh, salty waters and even in wastewaters.
- 3. They can be used as metal absorbers (Cu, Cd) in wastewater treatments.
- 4. Algae harvesting can be acted following a few days once the culture has began, which doesnot happen with crops.
- 5. Flue gases from power plants can be directly used in algae culture recovering carbon andnitrogen dioxides.
- 6. Algae production systems can be installed in surfaces next to industries and in non-cultivable surfaces, avoiding competition for the lands[29]

Table NO 2. Lipid Content Of Different Microalgae.(30,31,32)

Microalgae	Oil content(%dry weight)
Botryococcusbraunii.	25-28
Chorellaprotothecoides.	23-30
Chlorella vulgaris.	14-40
Crpythecodiniumcohnii.	20
Cylinderdrotheca sp.	16-37
Nitzschia.	45-47
Phaeodactylumtricornutum.	20-30
Schizochytrium sp.	50-77
Spirulina maxima.	4-9
Neochlorisoleoabunndans.	35-65
Crpythecodiniumcohnii.	20

VI. LITRATURE REVIEW

1)EZGI SUHEL AKTAS ET.AL. (2017)

Detail. As a result of the rapidly growing population and the developing industry, energy resources are becoming exhausted and therefore it is becoming increasingly necessary to find alternative energy sources.In this study, after giving general information about biodiesel and its sources, production methods are discussed in A sample study on the treatment of wastewater generated during the production of biodiesel is also included.

2)AGATA JABLO NSKA-TRYPU ET.AL. (2023)

The production of biofuels based on feedstock obtained through the exploitation ofarable land translates into an increase in food prices and progressive degradation of the environment.One of the manifestations of the deterioration of surface waters is the eutrophication of water reservoirs, which leads to an increase in the number of algae.Algae are a group of unicellular and multicellular organisms defined using morphological and ecological criteria and belong to the key producers in aquatic environment.When it comes to carbohydrates, the main group of compounds is polysaccharides,which perform reserve and structural functions in algae cells. Starch and glycogen are stored in plastids as storage components, while cellulose is the main structural component of the cell wall, as are sulfated polysaccharides.

3)MICHAEL KROGER ET.AL. (2014)

One of the future-generation biofuel options that has recently recieved increased attention is the production of biofuels from microalgae. Besides the use of algae oil for physicochemical biodiesel production, biochemical and thermochemical pathways are possible. Although there is still a need to research algae production systems, downstream processing (e.g., biofuel production) needs to be researched in parallel. As there are several methods to produce biofuel from algae, different possible production processes are reviewed. By investigating the different steps of each of the processes and highlighting the challenges and risks that can occur, it is possible to make a decision regarding which pathway might be feasible for algal resources in the future.

4)NAZIA HOSSAIN ET.AL. (2019)

The main objective of this study was to delineate the synergistic impact of microalgal biofuel integrated with nano-additive applications. Numerous nano-additives such as nano-fbres, nano-particles, nano-tubes, nanosheets, nano-droplets, and other nano-structures' applications have been reviewed in this study to facilitate micro algae growth to biofuel utilization. The present paper was intended to comprehensively review the nano-particles preparing techniques for microalgae cultivation and harvesting, biofuel extraction, and application of microalgae-biofuel nano-particles blends. Prospects of solid nano-additives and nano-fuid applications in the future on microalgae production, microalgae biomass conversion to biofuels as well as enhancement of biofuel combustion for revolution ary advancement in biofuel technology have been demonstrated elaborately by this review. This study also high lighted the potential biofuels from microalgae, numerous technologies, and conversion processes. Along with that, the study recounted suitability of potential microalgae candidates with an integrated design generating value-added co-products besides biofuel production.

5)SHIQIU ZHANG ET.AL.(2022)

Microalgae are the important part of carbon cycle in the nature, and they could utilize the carbon resource in water and soil efficiently. The abilities of microalgae to mitigate CO2 emission and produce oil with a high productivity have been proven. Hence, this third-generation biodiesel should be popularized. This review firstly introduce the basic characteristics and application fields of microalgae. Then, the influencing parameters and recent advanced technologies for the microalgae biodiesel production have been discussed. In influencing parameters for biodiesel production section, the factors of microalgae cultivation, lipid accumulation, microalgae harvesting, and lipid extraction have been summarized. In recent advanced technologies for biodiesel production section, the microalgae cultivation systems, lipid induction technologies, microalgae harvesting technologies, and lipid extraction technologies have been reviewed. This review aims to provide useful information to help future development of efficient and commercially viable technology for microalgae-based biodiesel production.[44]

6)DAVID A. WOOD ET.AL.(2021)

Microalgae with potentially high lipid yields of certain strains and relatively small environmental footprints offer a medium to long term biodiesel supply. Substantial challenges need to be resolved before they can be developed commercially on a large scale. There have been some significant technological breakthroughs made in recent years that offer the potential to achieve this. The ability to genetically engineer algal strains more efficiently and precisely to stabilize their growth and improve lipid yield is one approach. Others include one-step harvesting and lipid extraction from wet biomass, filtering incident light to focus on red photons, combining solar photovoltaics with high-rate algal ponds, and using wastewater and effluent to provide the ideal nutrient mix to promote algal growth and lipid yield. Additionally, microalgal extracts offer some value-added, high-margin co-products, such as poly-unsaturated fatty acids and nutrient-rich biofertilizers. Multi-product integrated biorefineries embracing offer the best route to large-scale, eco-friendly biodiesel commercialization.[45]

7) MILFORD A. HANNA ET.AL (1999)

Biodiesel has become more attractive recently because of its environmental bene®ts and the fact that it is made from renewable resources. The cost of biodiesel, however, is the main hurdle to commercialization of the product. The used cooking oils are used asraw material, adaption of continuous transesterication process and recovery of high quality glycerol from biodiesel by-product(glycerol) are primary options to be considered to lower the cost of biodiesel. There are four primary ways to make biodiesel, direct use and blending, microemulsions, thermal cracking (pyrolysis) and transesterication. The most commonly used method is transesteri cation of vegetable oils and animal fats. The transesteri cation reaction is aected by molar ratio of glycerides to alcohol, catalysts, reaction temperature, reaction time and free fatty acids and water content of oils or fats. The mechanism and kinetics of the transesterication show how the reaction occurs and progresses. The processes of transesteri cation and its down stream operations are also addressed.

8) BODJUI OLIVIER ABO ET.AL (2019)

Algae are increasingly emerging as one of the most promising sustainable and long-term sources of biomass and oils for fuel, feed food and other co-products. What makes them so attractive are the large number and wide variety of benefits associated with how and where they grow. This review presents added values and recent developments in resource recovery from microalgae. The main focus was in the cultivation and application of microalgae on biofuel recovery. Nearly all these benefits stem from the fact that these plants have evolved over billions of years to produce and store energy in the form of oil, and they do this more efficiently than any other known natural or engineered process. The results show that the investment in a microalgae biomass project can be associated with various processes, which include: growth of microalgae, harvesting, dehydration and extraction of oils. In addition, there are always project costs, which include engineering, infrastructure, installation and integration and contract fees.

9) MUHAMMAD IMRAN KHAN ET.AL (2018)

Microalgae have recently attracted considerable interest worldwide, due to their extensive application potential in the renewable energy, biopharmaceutical, and nutraceutical industries. Microalgae are renewable, sustainable, and economical sources of biofuels, bioactive medicinal products, and food ingredients. Several microalgae species have been investigated for their potential as value-added products with remarkable pharmacological and biological qualities. As biofuels, they are a perfect substitute to liquid fossil fuels with respect to cost, renewability, and environmental concerns. Microalgae have a signifcant ability to convert atmospheric CO_2 to useful products such as carbohydrates, lipids, and other bioactive metabolites. Although microalgae are feasible sources for bioenergy and biopharmaceuticals in general, some limitations and challenges remain, which must be overcome to upgrade the technology from pilot-phase to industrial level. The most challenging and crucial issues are enhancing microalgae growth rate and product synthesis, dewatering algae culture for biomass production, pretreating biomass, and optimizing the fermentation process in case of algal bioethanol production. The present review describes the advantages of microalgae for the production of biofuels and various bioactive compounds and discusses culturing parameters

VII. PLAN OF WORK.

1) Cultivation Techniques

↓

2)Collection Of Microalgae

↓

3)Algae oil extraction techniques

↓

4)Microalgae for Biodiesel Product

5)Material And Method

CULTIVATION TECHNIQUES:

Microalgae are the fastest growing species. The growing microalgae requires light, water, nutrients, CO2 Growing space temperature 20 ºC -30ºC. Microalgae capture CO2 and convert it to fuel by photosynthesis. They can capture CO2 from three different sources namely, atmosphere, waste gas from heavy industry and soluble carbonates. A lot of efforts have been made to enhance the productivity and the lipid content of some microalgae species by changing the growing.[33]

Two main cultivation systems are open system and closed system. The open system is normally a pond system, where the algae can grow naturally.[34] Microalgae are capable to grow rapidly. Their high photosynthesis efficiency coupled with the ability to accumulate a large amount of bioproducts within their cells make them a suitable candidate to serve as industrial raw material[35]. Besides,cultivation of microalgae does not require fertileland, a large quantity of freshwater, and herbicidesand pesticide when compared to the other cropsand thus will not be competing for resources[36]

A) Open Air System/Open Pond :

Open pond cultivation has been one of the oldest andsimplest ways to cultivate microalgae in large scale.Open pond is widely used in the industry due to itsrelatively cheaper construction, maintenance andoperation cost. Other advantages of using openpond system include simplistic operation and maintenance, low energy demand, and ease to scale up[37] Open-air systems, also known as open raceway ponds systems, are made of closed-loop recirculation channels, with a typical depth range of 10–50 cm. The ponds are keptshallow specically to allow adequate solar penetration for efcient photosynthesis of thealgal medium. These ponds incorporate paddle wheels, with daylong continuousoperation to prevent settling, for effective gas circulation and liquid mixing. It is open to the surroundings, which enables liquid evaporation and temperature regulation of theprocess.[38]

Raceway pond is one of the most frequentlyused open pond types for the cultivation of micro algae. It consists of a series of closed loop channel around 30-cm deep and paddlewheel which enable recirculation of microalgae biomass to ensure equal distribution of nutrients and prevent sedi mentation of microalgae biomass. Raceway pond has been perceived as one of the best open pond cultivation design available due to its energy efficiency, as a single paddlewheel is sufficient enough to properly agitate a 5-hectare raceway pond[39]

Figure No 5.Open Air System/Open Pond.

B)Closed Photobioreact System:

Photobioreactor is a bioreactor system used to culture phototrophs such as microalgae in an enclosed system which does not allow direct exchange of material between the culture and environment. Photobioreactor is able to overcome several constraints faced commonly by open pond culture design. First, the size of bioreactor is more compact compared to open pond, therefore providing more efficient land usage. Second, the system provides a closed and highly controlled growth condition for the culture, thus able to produce a contamination free, single strain micro algae culture.[40]

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 3 May-June 2024, pp: 902-914 www.ijprajournal.com ISSN: 2456-4494

COLLECTION OF MICROALGAE.

One of the major problems is algae collection because algae are mixed with water. The first step is to separate the biomass. After that, techniques of collection are used, in order to increase the concentration.[41]

- **There Are Several Types In Which The Collection Of Microalgae Is Performed:**

1) Filtration
2) Centrifugation
3) Flotation
4) Flocculation

ALGAE OIL EXTRACTION TECHNIQUES.

A) Mechanical Method:

1)1) Extraction expeller press.
2) Ulltrasonicassised extraction.

B) Chemical method:

1) Hexane solvent.
2) Soxhlet extraction.
3) Isopropyl acohol and prtroleum ether.

Microalgae for Biodiesel Product.

Biodiesel is a mixture of fatty acid alkyl esters obtained by transesterification (of vegetable oils or animal fats. These lipids feedstocks are included by 90–98% (weight) of triglycerides also small measures of mono as well as diglycerides, free fatty acids (1–5%), also residual measures of phospholipids, phosphatides, carotenes, tocopherols, sulphur compounds, and traces of water.[(42,43)]

Transesterification is a multiple step reaction, composing three reversible categories in series, where triglycerides are altered to diglycerides, followingdiglycerides are altered to monoglycerides, and monoglycerides are thenconverted to esters (biodiesel) and glycerol (by-product).[46,47]
Transesterification reaction can be catalysed both homogenous and heterogenous cataly[48].

Material And Method.

Apparatus:
Grinder,funnel,beaker, filter paper ,conical flask , separating funnel , stand ,simple distilatin apparatus.

Chemical:
Petroleum ether , Isopropyl alcohol.

Procedure:

1) FirstlyCollection Of Algae
2) Grinding The Microalgae By Mixture And Adding Some Amount Of Water.
3) After Thr Grinding This Microalgae Are Filtered Using A Watman Filter Paper.
4) Collect 500 Ml Filtrate
5) This Filtrate Are Transferred In To The Separating Funnel And Add The 125 Ml Of Petroleum Ether And 125 Ml Of Isopropyl Alcohol And Stir
6) This Separating Funnel Are StabeledIn The 4days
7) After 4 Days 3 Layer Are Observed .1st Layer Contain Pure Biodiseal 2nd Layer Contain Microalgae InpureBiodiseal And 3rd Layer Is Waste Material.
8) 1st Layer Is Pure Biodiseal Are Collected 2nd Layer InpureBiodiseal Are Purified Using A Simple Distillation
9) Simple Distillation Method:TheUnpureBiodiseal Are Placed In To The Rbfand Condencer And Reciver Are Joined Together.
10) When Heating Is Apply OnRBF The UnpuredBiodiseal Is Boil And Converted Into The Vapor.
11) The Vapor Get Into The Condencer And Converted Into The Pure Biodiseal.
12) The Biodiseal Are Collected This Biodiseal Are Volatile In Nature Therefor They Are Store In Well Close Container.

Step:

1) Algae:

Figure No 6.Grinding Algae

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 3 May-June 2024, pp: 902-914 www.ijprajournal.com ISSN: 2456-4494

2) Seperation.

Figure No 8.Seperating funnel.

3) Inpure Biiodiseal.

Figure No 9 .Inpure Biodiseal.

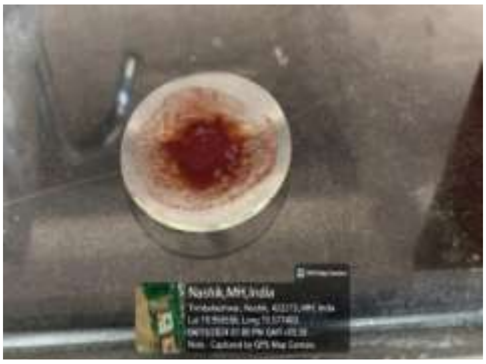
4) Simple Distilation.

Figure No 10. Simple Distilation

5) Pure Biodiseal.

Figure No 11.PureBiodiseal

Identification Test:
1) Lipid Test/ Sudan III Test:
A sample of biodiseal is mixed with sudanIIIdye solution if lipid is present they will form distinct red colouration in the mixture this indicate the presence of unsaturated fats or oil .



VIII. RESULT.

The below figure shows the twolayer:
1) UnPureedBiodisel
2) purebiodiesel.
1) unpuredbiodiseal:

Figure no 13 .Unpuredbiodiseal.

2) puredBiodiseal /Purification :
The UnpuredBiodisel can purified by using the Simple Distilation Method After purification the pure biodiesel obtained.

Figure No 14 .Pure Biodiseal After Purification

IX. CONCLUSION

Many companies and researchers have developed microalgae to biofuel systems, but as of yet there have not been any breakthroughs into commercial success. Many of the limitations are due to technological advancements in cultivation and harvesting, as well as in determining the optimal growth conditions for the microalgae.

According to U.S. Department of Energy, current research into efficient algal oil production is being done in the private sector but if predictions from small scale production experiments show promise then using algae to produce biodiesel may be the only viable method by which to produce enough automotive fuel to replace current world gasoline usage.

REFERENCE:

[1]. Nymark, M.; Sharma, A.K.; Sparstad, T.; Bones, A.M.; Winge, P. A CRISPR/Cas9 system adapted for gene editing in marine algae.Sci. Rep. 2016, 6, 24951.
[2]. Hopes, A.; Nekrasov, V.; Kamoun, S.; Mock, T. Editing of the urease gene by CRISPR-Cas in the diatom Thalassiosirapseudonana.Plant Methods 2016, 12, 49.
[3]. Chisti, Y., 2008. Biodiesel from microalgae beats bioethanol. Trends in biotechnology, 26(3), pp.126- 131
[4]. Krawczyk, T., 1996. Biodiesel ± Alternative fuel makes inroads but hurdles remain. INFORM 7, 801±829
[5]. Brennan, L. and Owende, P., 2010. Biofuels from microalgae—a review of technologies for production, processing, and extractions of biofuels and co-products. Renewable and sustainable energy reviews, 14(2), pp.557-577
[6]. Cantrell, K.B., Ducey, T., Ro, K.S. and Hunt, P.G., 2008. Livestock waste-to-bioenergy generation opportunities. Bioresource technology, 99(17), pp.7941-7953. Cantrell, K.B., Ducey, T., Ro, K.S. andHunt, P.G., 2008. Livestock waste-to-bioenergy generation opportunities. Bioresourcetechnology, 99(17), pp.7941-7953.
[7]. Das P, Aziz SS, Obbard JP. Two phase microalgae growth in the open system for enhanced lipid productivity. Renew Energy. 2011;36(9):2524–8.
[8]. Coustets, M., Joubert-Durigneux, V., Hérault, J., Schoefs, B., Blanckaert, V., Garnier, J.P. and Teissié, J., 2015. Optimization of protein electroextraction from microalgae by a flow process. Bioelectrochemistry, 103, pp.74-81.
[9]. Surendhiran, D. and Vijay, M., 2012. Microalgal biodiesel-a comprehensive review on the potential and Alternative biofuel. Research Journal of Chemical Sciences ISSN, 2231,60
[10]. https://byjus.com/biology/algae/
[11]. file:///C:/biodiseal/Algae%20Stock%20Photo%20-%20Alamy.htm
[12]. https://www.google.com/search?q=green+algae+scientific+name&sca_esv=577595109&rlz=1C1YTUH_en-GBIN1079IN1079&sxsrf=AM9HkKkpG5rrtPEaveANE

[13]. https://www.google.com/search?q=green+algae&sca_esv=577618083&bih=739&biw=1536&rlz=1C1YTUH_en
[14]. Guiry, M.D.; Guiry, G.M. (2016). "Algaebase". www.algaebase.org. Retrieved November 20, 2016.
[15]. Dodds, Walter K. (Walter Kennedy), 1958- (7 May 2019). Freshwater ecology : concepts and environmental applications of limnology. Whiles, Matt R. (Third ed.). London, United Kingdom. ISBN 9780128132555. OCLC 1096190142
[16]. W. J. Woelkerling (1990). "An introduction". In K. M. Cole; R. G. Sheath (eds.). Biology of the Red Algae. Cambridge University Press, Cambridge. pp. 1–6. ISBN 978-0-521-34301-5
[17]. https://www.google.com/url?sa=i&url=https%3A%2F%2Fvinciaesthetics.com%2Fwhat-are-red-algae-and-what-do-they-do-for-your
[18]. https://www.bluedragonessentials.com/wp-content/uploads/2019/09/what-exactly-is-bio-algae-concentrate.jpg
[19]. Alam, M.A.; Wang, Z.M. Microalgae Biotechnology for Development of Biofuel and Wastewater Treatment; Springer Nature: Singapore, 2019; p. 655. [Google Scholar] [CrossRef]
[20]. Patel, A.K.; Choi, Y.Y.; Sim, S.J. Emerging prospects of mixotrophic microalgae: Way forward to sustainable bioprocess for environmental remediation and cost-effective biofuels. Bioresour. Technol. 2020, 300, 122741. [Google Scholar] [CrossRef] [PubMed]
[21]. Barkia, I.; Saari, N.; Manning, S.R. Microalgae for high-value products towards human health and nutrition. Mar. Drugs 2019, 17, 304. [Google Scholar] [CrossRef]
[22]. Alam, M.A.; Xu, J.L.; Wang, Z. Microalgae Biotechnology for Food, Health and High Value Products; Springer Nature: Singapore, 2020; p. 483.
[23]. https://www.mdpi.com/2079-7737/11/8/1146
[24]. Hu Q. Environmental effects on cell composition. In: Richmond A. Handbook of Microalgal Culture – Biotechnology and Applied Phycologly. Oxford: Blackwell Science, 2004
[25]. Barbosa MJ, Janssen M, Ham N, Tramper J, Wijffels RH. Microalgae cultivation in air-lift reactors: modeling biomass yield and growth rate as a function of mixing frequency. BiotechnolBioeng 2003;82(2):170–9
[26]. Hu Q. Environmental effects on cell composition. In: Richmond A. Handbook of Microalgal Culture – Biotechnology and Applied Phycologly. Oxford: Blackwell Science, 2004.
[27]. Sherhan, 1. Dunahay, T., Bennemann, J. and Rossler, P. A look back at the US Department of energy's aquatic species program: biodiesel from algae. National Renewable Energy Laboratory, NREL/TP, (1998): 80-24190, USA
[28]. Nirbhay kumarsingh and dolly wattal Dhar. Nitrogen and phosphorous scavenging potential in microalgae. Indian journal of biotechnology, (2007):52-56
[29]. Rengel, A., 2008, July. Promising technologies for biodiesel production from algae growth systems.In The 8th European symposium of the international farming systems association, IFSA, Clermont-Ferrand,France.
[30]. Surendhiran, D. and Vijay, M., 2012. Microalgal biodiesel-a comprehensive review on the potential and alternative biofuel. Research Journal of Chemical Sciences ISSN, 2231, p.606X.
[31]. Kozlovska, J., Valančius, K. and Petraitis, E., 2012. Sapropel use as a biofuel feasibilitystudies. Research Journal of Chemical Sciences ISSN, 2231, p.606X.
[32]. Spolaore, P., Joannis-Cassan, C., Duran, E. and Isambert, A., 2006. Commercial applications of microalgae. Journal of bioscience and bioengineering, 101(2), pp.87-96.
[33]. Scragg, A.H., Morrison, J. and Shales, S.W., 2003. The use of a fuel containing Chlorella vulgaris in a diesel engine. Enzyme and Microbial Technology, 33(7), pp.884-889.
[34]. Khan, S., Siddique, R., Sajjad, W., Nabi, G., Hayat, K.M., Duan, P. and Yao, L., 2017. Biodiesel production from algae to overcome the energy crisis. HAYATI Journal of Biosciences, 24(4), pp.163-16
[35]. Randrianarison G, Ashraf MA. Microalgae: a potential plant for energy production. Geol Ecol Landscapes.2017;1(2):104–120.

[36]. Khan MI, Shin JH, Kim JD. The promising future of microalgae: current status, challenges, and optimization of a sustainable and renewable industry for biofuels, feed, and other products. Microb Cell Fact. 2018;17(1):36

[37]. Costa JAV, de Morais MG. An open pond system for microalgal cultivation. In: Pandey A, Lee D-J, Chisti Y, Soccol CR, editors. Biofuels from Algae. Elsevier; 2014.p. 1–22. DOI:10.1016/B978-0-444-59558-4.00001-2

[38]. Jorquera, O., Kiperstok, A., Sales, E.A., Embiruçu, M. and Ghirardi, M.L., 2010. Comparative energy life-cycle analyses of microalgal biomass production in open ponds and photobioreactors. Bioresource technology, 101(4), pp.1406-1413.

[39]. Rogers JN, Rosenberg JN, Guzman BJ, et al. A critical analysis of paddlewheel-driven raceway ponds for algal biofuel production at commercial scales. Algal Res.2014;4:76–88.

[40]. Posten C. Design principles of photo-bioreactors for cultivation of microalgae. Eng Life Sci. 2009;9 (3):165–177.

[41]. (41)) Andersson, V., Broberg, S. and Hackl, R., 2012. Integrated algae cultivation for municipal wastewater treatment and biofuels production in industrial clusters. Proceedings of WREF, Denver, USA, pp.13-7.

[42]. Mata, T.M., Martins, A.A. and Caetano, N.S., 2010. Microalgae for biodiesel production and other applications: a review. Renewable and sustainable energy reviews, 14(1), pp.217-232

[43]. Van Gerpen, J., 2005. Biodiesel processing and production. Fuel processing technology, 86(10), pp.1097-1107.

[44]. Shiqiu Zhang, LijieZhang,GengXu,Fei Li, Xiaokang Li,biodiesel production from microalgae, Influencing parameters and recent advanced technologies,national library of medicine,2022,1-20.

[45]. David A. Wood Review of recent progress,Bioresource Technology Reports,2021.

[46]. Baum, R., 1994. Microalgae are possible source of biodiesel"fuel. Chemical and Engineering News;(United States), 72(14).

[47]. Ma, F. and Hanna, M.A., 1999. Biodiesel production: a review. Bioresource technology, 70(1), pp.1-1.

[48]. Transesterification reaction can be catalysed both homogenous and heterogenous cataly.

[49]. Show PL, Tang MSY, Nagarajan D, Ling TC, Ooi C-W, Chang J-S. A holistic approach to managing microalgae for biofuel applications. Int J Mol Sci. 2017;18(1):215. https://doi.org/10.3390/ijms18010215.

[50]. Zeng X, Danquah MK, Chen XD, Lu Y. Microalgae bioengineering: from CO2 fxation to biofuel production. Renew Sustainable Energy Rev. 2011;15:3252–60.