A Review on Algae a Renewable Source of Energy

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ABSTRACT: ***The usage of energy sources has progressed to the point that the entire planet is reliant on it. Fuels are the most important source of energy since they are the most abundant. During the last few decades, there has been a growing concern about depleting available resources for biofuel production. In light of the food crisis, algae is receiving the most attention as a source of biofuel. This article discusses the benefits and drawbacks of solar energy technologies. As a result of its quick development rate and potential to be filled in squander water or waste land, green growth is believed to be a decent wellspring of sustainable power a few organizations and government offices are endeavoring to bring down capital and operational expenses in order to make algae fuel processing economically viable. The position of algae as a potential replacement for fossil fuel as a perfect biofuel reactant is the subject of this review article. As a result, this paper examines the advances made in algae research and development as a renewable energy source since its inception. Starting with a comprehensive overview of algae, their forms, and the biomass generated by them. It is also attempted to illustrate the existing and potential problems associated with the production of algae. It also aims to emphasize the importance of algae in the future.***

KEYWORDS*: Algae, Biomass, Environment, Renewable Energy, Water.*

INTRODUCTION

The worldwide demand for energy is growing at a high rate. As a main energy source, only fossil fuels are used. Sustainable power sources, for example, sun based, wind, hydro, flowing, and biomass have gotten progressively well-known all throughout the planet because of exhaustion of petroleum derivatives, rising oil-based fuel costs, energy protection, and expanded a worldwide temperature alteration. Biomass has been considered as a hotspot for biodiesel creation of biofuels, for example, biodiesel, bioethanol, and biogas from a scope of sources, including rural, ranger service, and oceanic. Then again, the ecological impact of fuel burning altogether affects the carbon cycle (carbon balance), which is connected to non-renewable energy source ignition. Moreover, the fatigue of different existing biomass without sufficient remuneration brought about enormous biomass shortage, just as arising natural issues like deforestation and biodiversity misfortune. As of late, analysts and business people have been especially keen on algal biomass as an elective feedstock for biofuel creation.

Given the fact that algae has been studied for over 70 years, global warming, fluctuating oil prices, and energy dependence on external countries have made it more important than ever. Japan developed commercial algae production systems for human consumption in the 1960s. There is now a boom of interest in biomass-based renewable energy sources due to the continuing increase in universal inhabitants and the significant improvement in fossil fuel use and demand. Biofuels made from agriculturally derived biomass are gaining popularity. This drive for agricultural-based biofuel production will result in less obvious issues such as eutrophication, resource degradation, reduced biodiversity, also, direct rivalry with current food crops because of current cultivating rehearses. Green growth are a fascinating elective feedstock for biofuel creation. Microalgae have a high absolute yield, resulting in a smaller land footprint and the ability to use land that would otherwise be unsuitable for food production. Furthermore, microalgae processing has the ability to use CO2 emissions, making it a carbon-neutral biofuel. While some algae are mixotrophic or heterotrophic, algae are by far the most abundant primary producers. In a biological context, the term algae refer to a group of lower plants that produce chlorophyll in their cells and are found in aquatic biotopes, but they are often found in other environments. Algae are grown and used in food all over the world. They are high in vitamins, minerals, fats, polyunsaturated fatty acids, antioxidants, and other nutrients.

Considerable research has been conducted on numerous perspectives of algae in various contexts. However, a systematic study of the current body of information is lacking. This type of systematic review is important not only for identifying common research sources, but also for highlighting potential research trends. This study aims to critically review a comprehensive overview of algae-related research in order to feature the present status of the craftsmanship and future requirements around here.

Algae:

The word "algae" refers to a varied group of organisms that can produce oxygen through photosynthesis. They are members of the Protista kingdom and come in a range of shapes and magnitudes. They might be single tiny cells, plainly visible and multicellular cells, live in settlements, or take on a verdant look, as on account of ocean growth like goliath kelp. Green growth vary from plants in that they are not unequivocally recognized. That is, they need genuine roots, stems, and leaves, just as a vascular framework that permits water and supplements to circle across their bodies.

These also come in a wide range of types and dimensions. They can be single minuscule cells, naturally visible and multicellular, live in states, or have a verdant look, as on account of ocean growth like goliath kelp. Picoplankton have a measurement of 0.2 to 2 micrometers, while monster kelp fronds can arrive at 60 meters long. Finally, algae can be found in a variety of freshwater and saltwater environments. The production of oxygen by photosynthesis is by far the most significant contribution of algae to our climate and well-being. These are important as it contain roughly half of the oxygen in the troposphere. The basic example of an Algae can be seen in Figure 1.

Figure 1: Algae may hold potential as both the food and the fuel of things to come.[1].

1. *Types of Algae:*

Algae pigment may be used to establish their habitat distribution. Only a few species of Algae are present in harsh environments such as snow, ice, or hot springs, despite the fact that the majority of Algae are found in aquatic ecosystems such as freshwater or sea water. Algae can be divided into four main categories, which are mentioned underneath:

1.1.Blue-Green Algae:

Cyanobacteria are the bacteria that make up blue-green algae. When scums die, they usually appear green but may also turn bluish. Large amounts of blue-green algae cause a variety of taste and odour issues, and certain species may produce toxins. Figure 2 depicts a simple example of blue-green algae.

Figure 2: **The figure illustrates about the common example of a blue-green Algae**[2]**.**

1.2.Green Algae:

Green Algae are members of the Chlorophyta phylum and include chlorophyll a, b, carotenoids, and xanthophylls. They come in two varieties: unicellular and multicellular. Although a few species can be found in the ocean, they are mainly found in freshwater habitats. These species, along with some members of the Chromista, Rhodophyta, and Photosynthetic bacteria, are called "Algae" because they are aquatic and provide their own food, despite having no close relationship with any of these groups. Figure 3 shows the most basic example of a Green Algae.

Figure 3: The figure illustrates about the common example of a green Algae.

1.3.Red Algae:

With over 6000 species, red algae are the oldest eukaryotic algae group. They are classified as Protista in the kingdom Protista and Rhodophyta in the phylum Rhodophyta. They produce chlorophyll and can use photosynthesis to prepare their own food. Freshwater red algae are mostly found in streams and rivers, but they can also be found in lakes, hot springs, soils, caves, and even sloth fur. Figure 4 depicts the simplest example of algae.

Figure 4: The Figure illustrates about the basic example of a Red Algae[3]**.**

2. *Biofuel Production Using Algae:*

Algae contain varying amounts of oil with various compositions reliant on the species. Some of these have been described as having high fatty acid standards. Similarly, certain algae have higher fatty acid content in their dry masses. Micro algae can thrive in a variety of environments, even when nutrients are scarce. It is better to choose them for cultivation. The processing of samples requires caution so that the entire biofuel content can be collected by careful instrument handling. The blending method is an easy way to remove fatty acids and separate biodiesel on a small or experimental scale. This procedure is broken down into several steps, as shown in Figure 5:

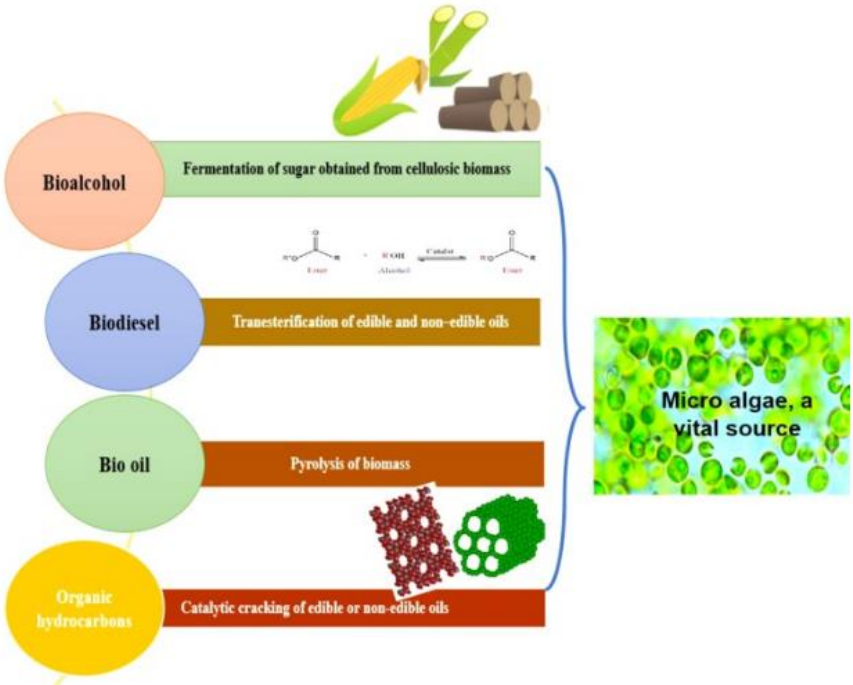

Figure 5: This Figure Illustrates The General Process Of Biofuel Production From Algae.

It's additionally fundamental to comprehend the algal development unit and whether it's smarter to utilize a shut framework or an open framework. Contingent upon the conditions and offices, like pH, temperature, type of algal specie, and measure of algal biomass, the batch or continuous process is verified. The most effective harvesting methods are dependent on a settling pond or a sedimentation tank. During the entire biodiesel production process, density and moisture must be adjusted. Spray drying is the most common drying method, but drum drying has also been recommended. The interruption instrument including mechanical handlings is believed to be the most favorable. Different determinations incorporate the utilization of solvents like hexane and ethanol in dynamic cycles. On the off chance that no different sources are accessible, ultrasound and microwave-based extraction techniques might be valuable.

LITERATURE REVIEW

In this paper author analyzed the thorough analysis of the Algae in this author also discussed some pervious researches towards it. The qualitative part of research consists of analysis of Algae and their type's biomass production from Algae major challenges and future scopes. The literature review is basically used to identify the major factors which are being involved in Algae. The following such researches are being mentioned below of the different authors to give Algae a balance review.

Suliman khan et al. presented an overview of Biodiesel Creation from Algae to conquer the Energy Calamity. The author of this paper concentrated on different methods for achieving the necessary biofuel quantities quickly and consistently in order to solve the fuel shortage. The situation of green growth as a possible substitution for non-renewable energy source as an ideal biofuel reactant is the subject of this audit article. Moreover, it was presumed that green growth development requires a reasonable environment, and that work on its development and collecting should be set up to such an extent that a lot of green growth can be created[4].

Shuvashish Behera et al., in this paper discusses about Algal biomass-derived third-generation biofuels which have been identified as the best alternative bio resource that avoids the drawbacks of first- and second-generation biofuels, according to studies. A however examination have done been while keeping the part of Algae as a significant sustainable wellspring of energy. Besides, notwithstanding it The significance of algal cell substance, just as different systems for item creation through different transformation innovations, are talked about in this examination, which inspects ongoing discoveries and progressed advancements in algal biomass for improved biofuel creation[5].

Simon Jegan et al, demonstrated and mentioned that In view of its fast development rate and potential to be filled in squander water or waste land, Algae is believed to be a solid wellspring of sustainable power, Several businesses and government agencies are attempting to lower capital and operational costs in order to make algae fuel processing economically viable. Finally, some of the emerging problems that need to be tackled in the future of algae were established, and it was inferred that microalgae for biofuels creation isn't simply proposed to bring in cash and backing the climate, yet additionally to assist individuals in the last billions with food and energy assurance [6].

After conducting research on the above-mentioned research paper, it can be concluded that while the research was conducted using various methods of algae, a balanced perspective was not given, as some research papers failed to address the major challenges and potential perspectives of algae as a renewable source of energy, which is a major concern. As a result, our research paper overcomes all of these limitations by carefully analyzing and mentioning all of these variables such as the complete overview about the Algae and their types and biomass generation through Algae so that it should be considered as an important source of renewable energy in such a way that they are easily understood, and most importantly, the major obstacles and possible viewpoints are clearly listed and discussed to give it a balanced view. This research is useful for those interested in learning more about studies in the field of algae, as it provides a comprehensive overview of algae, their forms, and biomass production by algae.

DISCUSSION

1. *Major Challenges and the Future Perspective of Algae:*

Algae biofuels have the potential to be a viable alternative energy source, but they must overcome a number of challenges before being widely accepted in the fuel industry. Strain detection and development, both in terms of oil productivity and crop conservation, nutrient and resource distribution and usage, and co-product production to improve the overall system's economics are among the challenges. Although there is a lot of excitement about algae biofuels' potential, there is still a lot of work to be done. In this section, we attempt to clarify the major obstacles to commercialising algal biofuels at scale, as well as improve the scientific community's focus on the subject.. We attempt to elucidate the major challenges to commercializing algal biofuels at scale in this segment, as well as strengthen the scientific community's emphasis on addressing these challenges and moving algal biofuels from promise to fact[7].

2. *Making Algal Growth & Harvesting More Efficient:*

Green growth biofuel creation would profit extraordinarily from improved designing. These improvements incorporate compelling supplement dissemination and light openness methods that have been recently examined. In synopsis, engineers face significant difficulties in either planning photograph bioreactors (PBRs) that are cheap enough for huge scope arrangement or teaming up with researcher to make species that flourish in minimal effort open frameworks. PBRs enjoy an upper hand over open frameworks in that they can all the more effectively support axenic societies and more controlled development conditions, which can add to expanded profitability; nonetheless, contained frameworks are undermined by gas trade efficiencies and the requirement for advantageous cooling. In spite of the advantages of lower pollution and higher productivity, it's obscure if PBRs will at any point be cost serious with open lake frameworks. Whatever development methodology is utilized, critical headways over current innovations for developing, reaping, and separating oil from green growth should be made, and deliberate endeavors will be expected to couple designer and researcher endeavors. Independent of the development system utilized, critical headways over current advances for developing, handling, and removing oil from green growth should be made, and coordinated endeavors to couple designing advances with improved yield strains will be required.

3. *Improving Oil Extraction & Downstream Processing:*

Another difficult that can be addressed most effectively by designing is oil extraction. Oil squeezes/expellers, hexane extraction, and supercritical CO2 liquid extraction are the three fundamental strategies for extricating oil from green growth. These advancements have all been effectively illustrated, yet they are generally exorbitant as far as either the hardware vital or the energy needed to remove the oil. Luckily, all can be improved by designing. Since unrefined green growth oil is artificially like rough non-renewable energy source oil, the designing difficulties engaged with changing over green growth oil to usable fluid energizes are like those looked by oil organizations, Another difficult that can be addressed most effectively by designing is oil extraction. Oil squeezes/expellers, hexane extraction, and supercritical CO2 liquid extraction are the three principle strategies for removing oil from green growth. These advances have all been effectively illustrated, however they are moderately expensive regarding either the hardware vital or the energy needed to remove the oil. Luckily, all can be improved by designing. Since unrefined green growth oil is synthetically like rough non-renewable energy source oil, the designing difficulties associated with changing over green growth oil to usable fluid powers are like those looked by oil organizations.

4. *Land Use:*

Despite the development procedure utilized or the proficiency with which oil is separated, the size of execution expected to substitute a lot of non-renewable energy source is considerable. To affect this figure, green growth, or some other biofuel feedstock, would require a lot of land devoted to creation offices, with gauges assessing that 30 million sections of land would be expected to fulfill US oil interest. Different models for accomplishing enormous scope hydroponics have been introduced. While both earthbound and marine procedures might be required, we will focus on earthly hydroponics in this article since marine techniques are right now obscure and may require designing. While both earthly and marine methodologies might be required, we will focus on earthbound hydroponics in this article since marine systems are as of now obscure and may include designing that is generously not the same as what is right now rehearsed. The earthly models utilize land that isn't right now utilized for food creation and has minimal set up natural or monetary worth.

5. *Water Use:*

Water can possibly be a critical restricting element in algal turn of events. Water would be expected to extend algal development into nonarable land; fortunately, a considerable lot of these spaces have huge soluble or saline water saves under them, giving a critical wellspring of nonpotable water appropriate for some algal species' development. To supplant the water lost in dissipation, green growth filled in open lakes have water prerequisites per unit territory equivalent to cotton or wheat, yet not as much as corn (for an outline of water necessities of earthbound plants utilized in biofuel creation see. While pondering an enormous scope sending of green growth, it's basic to consider water utilization to forestall a potential "water versus fuel" banter. Notwithstanding the accessibility of huge antacid supplies, water will keep on being a significant worry for green growth biofuels creation and should be painstakingly considered as the business develops.

6. *From The Bench To The Pond: Strategies To Make Algae Biofuels Viable:*

A blend of elements, including financial feasibility and the apparent advantage of CO2 relief by this innovation, will decide if green growth turns into a huge scope biofuel maker. Moreover, early advances in both the business and scholarly universes will energize support for the examination needed to refine and approve this innovation. We made a worked on monetary investigation utilizing a Scenedesmus spp., which yielded 0.21 g/l/day of biomass with a lipid substance of 21%, to get a feeling of the conceivable advancement required. For this life form to be monetarily attainable at these development and lipid amassing rates utilizing current creation advances, oil based oil should cost about $710 per barrel in our model. The meaning of development thickness according to development rate is one of the model's amazing discoveries.

In spite of the way that development rate is basic for generally profitability, our model predicts that higher development densities support monetary reasonability more rapidly than a corresponding expansion in development rate, since the expense of collecting and fuel extraction exceeds the capital expense of building a bigger office to accomplish a similar by and large all out yield. In the event that we accept that point by point portrayal of existing species will prompt the recognizable proof of an animal types with a development pace of 0.3 g/l/day and a 40% oil content, the cost of green growth oil would be about $310 per barrel. This number might be improved with rearing and determination or sub-atomic hereditary qualities to additionally amplify the advancement strain, yet because of the intricate connection between development rates and oil amassing, there is no assurance that a strain with these attributes will be found. Essentially, since various expenses certain in the model are presumptions dependent on past work by others, it is highly unlikely to confirm that our model is precise, and extrapolated from conventional farming information.

We've spoken about how to make green growth based powers more affordable than petrol. Bioprospecting is basic for distinguishing algal species with attractive qualities (e.g., high lipid content, high development rates, high development densities, as well as the presence of valuable co-items) that can be become on minimal effort media. Notwithstanding the system's latent capacity, the most plausible situation is that bioprospecting would neglect to discover living beings that are cost cutthroat with oil, requiring more hereditary designing and rearing to convey these strains to business reasonability. From improving lipid biogenesis and harvest wellbeing to creating helpful chemical or protein co-items, the scope of potential for designing green growth is simply starting to be figured it out. No manageable innovation is without its downsides, yet advancing them without considering the drawn out results which lead to the selection of techniques whose drawn out outcomes exceed their momentary advantages. We've spread out what we accept are the most squeezing current and future issues confronting green growth biofuels, however as in any new industry, the more we study, the more we understand there are difficulties we hadn't anticipated. Despite these uncertainties, we expect that algae-based fuel production will be cost-competitive, broadly scalable, and deployable within the next 7–10 years, but only if we continue to improve our understanding of these incredible organisms while also improving our ability to engineer them for the specific task of developing a new energy industry[8].

CONCLUSION

The search for alternate renewable energy sources to replace fossil fuels has recently become a challenge. Because of a scope of benefits, for example, little land prerequisites for biomass creation and high oil content with high productivity, algal biofuels have been evaluated as the best asset for supplanting fluid oil fuel. Low biomass production is one of its bottlenecks, which is an obstacle to industrial production. All stages of algae biofuel processing, especially drying, should be simplified without requiring a large amount of energy for long-standing sustainability and conservational profits. Furthermore, the processes should be simple to incorporate into the prevailing biofuels industry and executed quickly, especially in the third-world countries. This is since growing microalgae for biofuels isn't just about making money and helping the environment; it's also about helping people in the bottom billions with food and energy protection.

This paper has covered a variety of topics related to algae, which plays an important role in creating a sustainable smart environment. The description of Algae, in particular, has been completed. In addition, the development of biomass from algae, as well as a number of major challenges and potential perspectives, have been discussed. This research is beneficial to those who want to learn more about studies on algae as a renewable energy source. This paper also discusses the current state of algae and its possible future in order to provide a balanced perspective.

REFERENCES

[1] A. Vidyasagar, "What Are Algae?"

[2] "What are blue-green algae?" .

[3] Jennifer Frazer, "Why Red Algae Never Packed Their Bags for Land," *Scientific american*.

[4] Suliman khan et al, "Biodiesel Production From Algae to Overcome the Energy Crisis," *Sciencedirect*, vol. 24, no. 4, 2017.

[5] Shuvashish Behera et al, "Scope of algae as third generation biofuels," 2015.

[6] Simon Jegan et al, "Microalgae as a Renewable Source of Energy: A Niche Opportunity," 2014.

[7] Srikanth Reddy Medipally et al, "Microalgae as Sustainable Renewable Energy Feedstock for Biofuel Production," 2015.

[8] Kiyafat ULLLAH ET AL, "Algal biomass as a global source of transport fuels: Overview and development perspectives."