Journal of Advanced Zoology
ISSN: 0253-7214
Volume 45 Issue 1 Year 2024 Page 508:510

Recent Advancement Of Algal Biofuel Production And Its Potential Uses

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Abstract

The utilization of diverse energy sources is linked to the growth of industry, agriculture, and transportation. After the third generation of biodiesel production began, it was anticipated that algae would emerge as the most advantageous source because it not only can accumulate large amounts of lipids but also has the potential to reduce the amount of agricultural land required for the production of biofuels and enhance air quality by capturing carbon dioxide. In contrast to the price of making biodiesel from crops, the cost of algal biomass cultivation and processing poses a significant issue. The first step is to use genetic engineering to boost the lipid content of algal cells. The promotion of enhanced lipid accumulation by stressing algae is related to the second way. The third direction entails looking for new, promising strains of algae that will differ from the currently recognized strains in their ability to collect biomass more quickly, have greater Triacylglycerols [TAG] concentrations, and accumulate saturated and unsaturated fatty acids in the right ratios. By defining the evolutionary relationships within the main taxonomic groups of algae, a new technique in the search for biotechnologically relevant strains of algae has recently been developed. These investigations have resulted in a significant cost decrease for the manufacture of biofuel based on algae biomass. All of this research aimed at improving algae biofuel production and exploring additional biofuel sources is crucial.

Keywords: Algal biofuel, Algal biomass, Biofuel, Biodiesel, Lipid accumulation.

Introduction

Bio algae can be used in many ways to prevent future fuel shortages e.g.: Biofuel Biodiesel Bioethanol. The initial generation of biofuels, including bioethanol, biobutanol, and biodiesels, are typically produced using conventional crops or animal fats chemically (Lee and Lavoie 2013; Maity et al., 2014) (Table 1).

Table 1: The three generations of biofuels

	1st generation	2nd generation	3rd generation
Feedstock	Wheat barley, corn, sugarcane, sugar beet, potato, plant oil.	Lignocellulosic, biomass, Agriculture waste, forest waste, Municipal solid waste	Microalgae, microalgae microbes.
Product	bioethanol, biodiesel, vegetable oil	bioethanol, biomethane, Fischer-tropsch gasoline and diesel.	Biodiesel, biomethane, biohydrogen

First-generation biofuels are versatile and efficient, suitable for petroleum-based fuel blends and internal combustion engines, but their use of food-based crops may increase food prices (Naik et al., 2010). Large agricultural areas for biomass production cause the competition between food and biofuel production to be a significant issue leading to environmental issues are a significant concern that require urgent attention and action like land clearing. The degradation of habitats, depletion of water, and air pollution are significantly impacting biodiversity and ecosystems (Brennan and Owende, 2010). Second-generation biofuels like bioethanol and biodiesel are primarily produced from non-diverse lignocellulosic biomass, including agricultural and forest wastes, municipal solid wastes, and manures like Jatropha, cassava, and Miscanthus (Maity et al., 2014). Second-generation biofuels provide a cost-effective alternative to first-generation biofuels by utilizing inedible, infertile plants and infertile lands, which are not directly competitive with food production due to their unique growth and inedibility (Arora et al., 2021). Second-generation biofuels are facing challenges in their development and production. The text delves into the obstacles encountered in pretreatment The intricate structures of lignocellulosic materials often result in inefficient conversion (Lee and Lavoie, 2013). Algae-derived biomass has shown superior capabilities in producing third-generation biofuels, providing previous studies suggest that renewable energy sources can be a cost-effective alternative to fossil fuels (Ullah et al., 2015). Seaweed microalgae, which can produce crude oil, diesel, gasoline, and ethanol, are the most promising biomass for replacement The use of petroleum-derived transport diesel is being explored without any adverse effects on the food supply or crop products making them a potential alternative to conventional crops (Chisti, 2008).

Various types of Algae Biofuels

Algae biofuels, derived from biomass sources like forests, farms, and aquatic environments, offer an eco-friendly, economical, and sustainable alternative to traditional fuels. Techniques for transforming algae.
Biodiesel, bioethanol, biohydrogen, bio-oil, and biogas are all produced through various methods such as transesterification, fermentation, pyrolysis, anaerobic digestion, and pyrolysis.

The article discusses the challenges faced by algae biofuels.

Algae biofuels, produced from algal biomass, have potential as a replacement for traditional fossil fuels. However, their large-scale production remains underdeveloped, necessitating revisits to address technology-related issues. Table 2 provides detailed information on these challenges in algae biofuel production.

Table 2: The article discusses the challenges faced by algae biofuels.

Challenges	Character
Pollution	The cultivation of algae poses a significant challenge in preventing contamination.
Production cost is high.	Algal biofuel production is becoming more expensive compared to fossil fuels.
Field usage	The large size of algae cultivation could potentially disrupt farming and wildlife habitat protection activities.
Scalability	Scaling is a significant challenge in algae farming.
Temperature	Environmental changes, such as changes in air, water, and light conditions, can significantly impact the growth and yield of algae.
Water multiplication	The technological challenge of maintaining water quality in an industrial-scale algae farm is significant.

Conclusion

This chapter discusses the benefits of algae as a crucial feedstock for biofuel production, comparing the first, second, and third generations of biofuels. It reviews the entire process, from cultivation to conversion, in sequential order. Technologies for growing algae have been discussed, along with their benefits and drawbacks. As a tool for technology selection, a wide range of harvesting techniques have been examined based on their benefits and drawbacks. The technologies for converting the gathered algal biomass have been described, along with several suggestions for process improvement.

This chapter also compares the efficiency of biodiesel, bioethanol, biogas, and biohydrogen with that of conventional fuels to assess their appropriateness and usefulness as biofuel products. Additionally, the biorefinery concept is being emphasized, which enables the integration of various industrial units or integration inside a biomass production plant by recycling nutrients and CO_2. Based on the technological bottlenecks of the present, future outlooks and commercial possibilities of algae biofuel have been analyzed and a few recommendations have been made.

Acknowledgment

We express our gratitude to Swami Vivekananda University for providing us with the necessary facilities for conducting our research.

Conflicts Of Interest

The authors have declared no conflict of interest.

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