Chapter 13
Microalgae Biofuels:
Challenges and Potential

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ABSTRACT

Development of sustainable energy resources is a major concern in front of the scientific community and stakeholders in this field. Invariably, fossil fuels are utilized to meet the major part of energy demand all over the world, but their stocks are limited. Burning of fossil fuels also causes significant environmental pollution that results in drastic climate change. There is an emergent need of an alternative to fulfill the current energy demand in a sustainable way along with sorting out the pollution issues. Microbial biofuels could be the most appropriate choice in this regard because it bears enormous potential that needs to be exploited. But it has some challenging issues to employ it to meet out the current energy demands. This chapter illustrates the microbial biofuels, harvesting techniques, different process, and potential to utilize them as sustainable energy sources along with considerable challenges that need to be addressed to make it an eco-friendly and economic fuel choice to pave the path of sustainable development.

INTRODUCTION

The scarcity of fossil fuel resources and the catastrophic environmental consequences caused by their use are major global concerns today. Fossil fuels have resulted in massive and long-term damage to our environment, including acid rain, global warming, and climate change. Greenhouse gas emissions continued to increase, and in 2010, they reached up to 30.6 gigatonnes (GT). The OECD (Organization for Economic Co-operation and Development) suggested that without implementing more effective policies than in force today, it will increase by another 50% by the end of 2050. It is anticipated that without taking appropriate measures, the atmospheric concentration of greenhouse gases would be reaching 685 ppm CO_2-equivalents by 2050. This is well above the 450ppm level of CO_2 required to have at least a 50% chance of increasing the global average temperature to 2°C. As per OECD predictions, the global average temperature is likely to exceed an increment of 2°C by 2050 and rises to 3 to 6°C greater than the pre-industrial levels by the end of this century. The United Nations Environment Programme (UNEP) "Emission Gap Report 2019", unless the greenhouse gas emissions must fall by 7.6% each year from 2020 to 2030, the world will fail to meet the 1.5 °C temperature reduction goal of the Paris agreement. (UNEP, 2019). Such a high rate of temperature rise would continue to change rain patterns and the melting of glaciers, leading to rising sea levels and worsening weather events. It could also exceed some critical "tipping points", resulting in dramatic natural changes resulting in irreversible or catastrophic events for natural systems and society (OECD, 2012). Also, fossil fuel reserves are depleting very fast. The growing economy needs fossil fuels to function, from the production of plastics and agricultural fertilizers to the energy requirements for heating, lighting and transportation services. Rapidly growing industrialization and the exploding world population are the driving force to become increasingly dependent on fossil hydrocarbons for economic growth (Ahmed et al., 2021). The fossil fuel demand is predicted to grow by 40% from 2010 to 2040 (Bhore et al., 2019). Fossil fuel reserves are insufficient to meet rising demand at the current consumption rate and will be exhausted soon. An overreliance on fossil fuel supplies challenges the world's energy security resilience. It will lead to a dwindling of fossil fuel resources and is expected to exhaust in less than 80 years (Rafa et al., 2021). The majority of the world's energy demand is fulfilled by fossil fuels (approximately 80%), with biofuels (11.3%), nuclear energy (5.5%), and other renewable energy sources, such as wind, filling in the gaps (2.2%) (Kopplaar, 2012). According to the International Energy Agency (IEA), biofuels will be contributing more to total energy sources by 2030. It could be expanded significantly if new petroleum fields are not accessed or substantial new alternatives are not identified (Hannon et al., 2010). Biofuels are among the most sustainable options. Biofuels and other renewable energy sources, such as wind and solar power, have attracted researchers, industrialists, and administrations to address energy shortages, rising crude oil costs, global climate change, and land and water degradation (Alam et al., 2015). This chapter entails a detailed description of microbial biofuels and their potential and contemporary challenges to make their most appropriate economically viable and sustainable choice of energy demands.

Biofuels

Biofuels have a zero-carbon footprint and are renewable fuels that are essential for environmental and economic sustainability. Any solid, liquid, or gaseous fuel derived from biomass (plants, animal waste, manure, sludge, etc.) stores solar energy through physical and chemical processes. This energy source can replace fossil fuels (Mobin & Alam, 2018). The usages of biofuels have several over conventional

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