



Optimizing Microalgae Cultivation for Wastewater Phytoremediation and Biodiesel Production

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ARTICLE INFO	
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Citation: Hatami B, Ebrahmi AA, Rezaie A. *Optimizing Microalgae Cultivation for Wastewater Phytoremediation* and *Biodiesel Production*. J Environ Health Sustain Dev. 2024; 9(2): 2237-8.

In recent years, with the growth of the population and the increase in the rate of agricultural and industrial activities, the amount of water consumption has increased. This has caused problems due to the lack of freshwater sources and the large volume of produced wastewater¹. Therefore, to solve this problem, extensive studies have been conducted on using different wastewater treatment systems to recycle the resulting effluent for non-sanitary and industrial applications¹. Unfortunately, many conventional wastewater treatment technologies relying on physical and chemical processes are not cost-effective, primarily due to their high expenses².

Recently, scientists globally have turned their attention to the innovative use of living microorganisms to improve various processes, particularly wastewater treatment². Among these microorganisms, microalgae have shown significant promise due to their exceptional capacity to eliminate a variety of contaminants, including nitrogen, phosphorus, and toxic metals, from different wastewater sources³.

Microalgae encompass a diverse group of microorganisms derived from plant species that

can thrive in environments rich in organic matter, nitrogen, and phosphorus^{4,5}. Consequently, due to the high availability and accessibility of these nutrients in wastewater, this medium can serve as a cost-effective source of nutrients for cultivating microalgae^{6,7}. Reports have shown that microalgae synthesis effectively removes dissolved heavy metals such as chromium and cadmium by producing metal-chelating exopolysaccharides in conditions of high metal concentration⁵. In conventional wastewater treatment plants, large volumes of sludge are produced as byproducts, necessitating costly treatment and disposal. Therefore, cultivating microalgae in wastewater as part of an engineering system provides biomass with high economic value instead of generating sludge⁴.

Given that fossil fuel sources are non-renewable, depleting, and contribute to pollution and global warming, developing sustainable and environmentally friendly energy sources is essential to support modern societies⁸. One promising energy source is bioenergy, which includes biomethane, bioethanol, biobutanol, and biodiesel produced from photosynthetic organisms. Bioenergy has several advantages compared to petroleum diesel, being primarily renewable, biodegradable, low in toxicity, and free of sulfur and aromatic compounds⁹.

Microalgae typically consist of a diverse range macromolecules, including carbohydrates of (approximately 12% to 30% of their composition), lipids (4% to 20%), and proteins (30% to 70%), with variations depending on the specific species of microalgae. These intricate biological structures play a crucial role in the physiology and metabolism of microalgae, influencing their growth, nutritional content, and applications¹⁰. Many microalgae species achieve higher lipid productivity than traditional crops, making them substrates potential for biodiesel fuel production^{5,11}. Additionally, these organisms can stabilize CO2 in the environment by using it as a carbon source for growth and reproduction. Therefore, biofuel production from microalgae is a promising alternative to conventional technologies¹².

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References

- 1.Radin Mohamed RM, Chan CM, Wurochekke AA, et al. The use of natural filter media added with peat soil for household greywater treatment. GSTF Journal of Engineering Technology (JET). 2014;2:1-6.
- 2.Subhash GV, Rajvanshi M, Kumar GRK, et al. Challenges in microalgal biofuel production: a perspective on techno economic feasibility under biorefinery stratagem. Bioresource Technology. 2022;343:126155.
- 3.Pandey S, Narayanan I, Selvaraj R, et al. Biodiesel production from microalgae: a comprehensive review on influential factors,

transesterification processes, and challenges. Fuel. 2024;367:131547.

- 4.Song X, Kong F, Liu BF, et al. Combined transcriptomic and metabolomic analyses of temperature response of microalgae using waste activated sludge extracts for promising biodiesel production. Water Research. 2024;251:121120.
- 5.Moshood TD, Nawanir G, Mahmud F. Microalgae biofuels production: a systematic review on socioeconomic prospects of microalgae biofuels and policy implications. Environmental Challenges. 2021;5:100207.
- 6.Song X, Liu BF, Kong F, et al. New insights into rare earth element-induced microalgae lipid accumulation: implication for biodiesel production and adsorption mechanism. Water Research. 2024;251:121134.
- 7.Nazloo EK, Moheimani NR, Ennaceri H. Biodiesel production from wet microalgae: progress and challenges. Algal Research. 2022; 68:102902.
- 8.Bashir MA, Wu S, Zhu J, et al. Recent development of advanced processing technologies for biodiesel production: a critical review. Fuel Processing Technology. 2022; 227:107120.
- 9.Cho S, Luong TT, Lee D, et al. Reuse of effluent water from a municipal wastewater treatment plant in microalgae cultivation for biofuel production. Bioresource Technology. 2011; 102(18):8639-45.
- Mata TM, Martins AA, Caetano NS. Microalgae for biodiesel production and other applications: a review. Renew Sustain Energy Rev. 2010;14(1):217-32.
- 11. Show PL, Tang MS, Nagarajan D, et al. A holistic approach to managing microalgae for biofuel applications. International journal of molecular sciences. 2017;18(1):215.
- 12. Guo Z, Liu Y, Guo H, et al. Microalgae cultivation using an aquaculture wastewater as growth medium for biomass and biofuel production. Journal of Environmental Sciences. 2013;25:S85-8.

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