

Microalgae Pre-Concentration Technologies for Sustainable Biofuel Production: Insights from the ALGAESOL Horizon Europe Project

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Microalgae have emerged as a promising feedstock for renewable fuels due to their rapid growth rates, high lipid content, and ability to treat wastewater while converting CO₂ into organic compounds with the energy provided from sunlight [1]. However, the commercialization of microalgae-derived biofuels remains hindered by high production costs, particularly during the energy-intensive biomass harvesting and lipid extraction stages [2]. Conventional harvesting methods such as centrifugation, flocculation, and filtration account for up to 30% of total production costs, with significant energy demands and scalability limitations. The ALGAESOL Horizon Europe Project addresses these challenges, focusing on developing scalable, energy-efficient microalgae pre-concentration (factor >10) technologies using membrane systems prior to centrifugation as shows Fig. 1. The membranes will be based on Nanofibers (NFs) using electrospinning technique, considering both pressurized and submerged membrane systems. The unique structure of nanofiber membranes, characterized by high porosity and interconnectivity, helps enhance filtration performance such as permeability. The NFs-based systems will optimize accounting various aspects of the process, including maintenance and operational parameters (backwash, relaxation, air bubbles, and chemical cleaning), membrane composition (focusing on mechanical strength through post-treatments), and membrane fouling characteristics (critical flux, crossflow velocity, recovery, and cleaning techniques). By concurrently optimizing the combined membrane-centrifugation harvesting parameters and energy requirements, this comprehensive approach aims to overcome existing limitations in microalgae harvesting, potentially reducing production costs and enhancing the commercial viability of microalgae-derived biofuels.

Keywords: *electrospun nanofiber membranes, microalgae pre-concentration, sustainable biofuels*

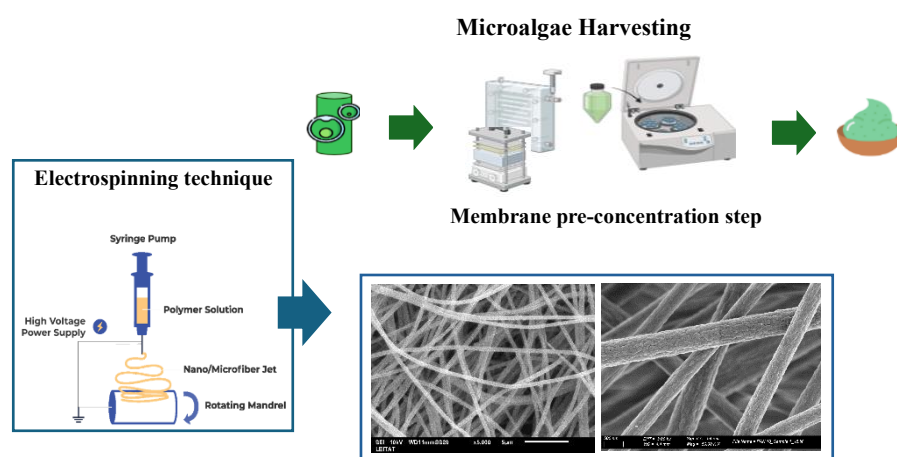


Figure 1. Microalgae pre-concentration with membranes combined with centrifugation to significantly reduce energy consumption.

Literature

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