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Chlorella sorokiniana - based phycoremediation of dairy industry wastewater: An economical method of producing biodiesel

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Abstract

The potential of a recently identified strain of *Chlorella sorokiniana* for biodiesel generation and dairy wastewater (DWW) phycoremediation was investigated in this work. Dairy wastewater dilutions of 50 %, 60 %, 70 %, 80 %, and 90 % were used to develop microalgae, and their growth was compared to that of synthetic Amaral media. The findings showed that *C. sorokiniana* grew robustly in all wastewater dilutions, with the 90 % dilution producing more biomass (0.47 g/L/d) and cell concentration than the synthetic medium. Higher wastewater concentrations resulted in a rise in chlorophyll content, which peaked at 20.24 μg/L at 90 % DWW. The largest accumulation was seen in 90 % DWW, accounting for 40.33 % of the dry weight biomass, according to lipid content analysis. Fatty acid profiling revealed a predominance of palmitic acid (C16:0), oleic acid (C18:1), and linoleic acid (C18:2) across all treatments. The proportion of saturated fatty acids slightly increased with higher wastewater concentrations, while monounsaturated fatty acids decreased and polyunsaturated fatty acids remained relatively stable. The results indicated that moderate dilution of 60 % wastewater resulted in the highest nitrate removal efficiency (75 %). Phosphate removal remained consistently high (85%–98 %) across all dilutions. The biodiesel properties derived from wastewater-cultivated algae met the ASTM D6751 and EN14214 standards, with improvements in the cetane number and cloud point at higher wastewater concentrations. This study demonstrated the feasibility of using dairy wastewater as a cost- effective and sustainable medium for microalgal cultivation, offering the dual benefits of wastewater phycoremediation and high-quality biodiesel feedstock production. The findings highlight the potential for integrating algal cultivation with dairy industry waste management, contributing to circular economic principles in the biofuel sector.

Keywords: Biofuel, dairy wastewater, FAMEs, lipid productivity, microalgae, wastewater treatment

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