

Phycoremediation of food industry wastewater: a sustainable approach for nutrient recovery, pollution mitigation, and biofertilizer production for tomato cultivation

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ABSTRACT

The increasing generation of nutrient- and pollutant-rich wastewater from the food industry poses significant environmental threats. This study explores phycoremediation as a sustainable and dual-benefit approach for wastewater treatment and agricultural enhancement. Indigenous microalgal strains were isolated and screened for their efficacy in treating food industry wastewater (FIW) through nutrient assimilation and pollutant removal. Over a 10-day treatment cycle, significant reductions were observed in BOD (75%), COD (62%), total nitrogen (67%), and phosphorus (72%), improving the effluent's suitability for agricultural reuse. The harvested algal biomass was formulated into a nutrient-rich biofertilizer, containing essential macronutrients (NPK), micronutrients, and beneficial microbial populations. Tomato (*Solanum lycopersicum*) cultivation trials using treated wastewater (TFIW) and the formulated biofertilizer showed improved germination rates, growth indices, physiological resilience, and yield metrics comparable to those obtained under freshwater irrigation. In contrast, untreated FIW adversely affected plant performance and soil quality. The findings highlight the potential of microalgae-based wastewater treatment in integrating environmental remediation with sustainable agriculture, supporting circular bioeconomy models and reducing reliance on synthetic fertilizers and freshwater resources.

Keywords: *Biofertilizer, Circular Bioeconomy, Food Industry Wastewater, Microalgae, Phycoremediation, Pollution Mitigation, Sustainable Agriculture, Tomato Cultivation and Wastewater Reuse*