

Microalgae-based valorization of agro-industrial effluent: a step towards circular bioeconomy

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Winery distilleries generate effluents with high organic and nutrient loads that remain poorly reduced even after anaerobic digestion and stabilisation. This work evaluates native microalgal communities established in a stabilisation pond at a Portuguese distillery (Destilaria Ferreira Gomes & Filhos) as a bioremediation route for effluent polishing ahead of discharge. Microscopy showed a mixed community dominated by unicellular, ovoid to ellipsoidal cells with green chloroplasts, together with co-occurring bacteria. Batch growth trials compared three inocula: a BG11-cultivated reference strain, a native effluent strain subcultured without pH control, and an effluent-adapted culture carried over after ten days and grown under pH control. Biomass was tracked by optical density and calibrated against a gravimetric method. Nutrient removal was assessed through standard wastewater parameters: COD, BOD5, total nitrogen, total phosphorus and ammonia nitrogen. pH control improved growth kinetics and shortened the lag phase relative to the uncontrolled trial. The effluent-adapted culture reached the highest final biomass concentration among the three conditions. Nitrogen and phosphorus removal was consistently stronger than the reduction in organic load. Native, effluent-adapted microalgae reduce the polluting potential of distillery wastewater and generate biomass with downstream valorisation potential. Molecular identification of the consortium and scale-up in photobioreactors are the next steps of this research.

