Abstract:

This study investigates the potential of microalgae in the sustainable remediation of dairy effluent, emphasizing the generation of valuable biomolecules. Dairy effluent, rich in nitrogen, phosphorus, and trace metals, serves as an excellent medium for cultivating microalgae, which play a dual role as bioremediators and producers of compounds such as lipids, proteins, and carbohydrates. The study focuses on autochthonous microalgal strains isolated from dairy effluent, exploring their capacity for waste-to-bioproducts transformation.

Ten microalgae isolates were screened, and two promising strains, DWW06 (identified as *Botryococcus sp.*) and DWW08 (identified as *Poterioochromonas melhamensis*), were selected based on growth kinetics. Both strains were evaluated for nutrient removal, biomass, and lipid productivity in different concentrations of dairy waste water (DWW). Results indicate that both isolates effectively remediate DWW, with optimal growth observed in 75% DWW concentration.

DWW06 demonstrated a biomass productivity of 88.00 ± 0.003 mg/L/day and exhibited high nitrate and phosphate removal efficiencies of 84.96% and 86.45%, respectively. The strain also showed significant chemical oxygen demand (COD) removal of 86.45%. The lipid content of DWW06 reached 29.80 ± 0.002 g/L, with a lipid productivity of 26.22 ± 0.004 g/L/day.

DWW08 exhibited superior biomass productivity at 93.73 ± 0.006 mg/L/day and achieved nitrate and phosphate removal efficiencies of 87.45% and 88.90%, respectively. The strain demonstrated substantial COD removal of 88.84%. DWW08's lipid content peaked at 31.61 ± 0.003 g/L, with a lipid productivity of 29.61 ± 0.003 g/L/day.

Both strains, especially DWW08, showcased the potential for simultaneous remediation of dairy effluent and production of valuable lipids. The lipid profiles of both strains, analyzed through GC-MS, revealed compositions suitable for various commercial applications.

In conclusion, this study highlights the effectiveness of microalgae, particularly *Botryococcus sp.* and *Poterioochromonas melhamensis*, in remediating dairy effluent while yielding valuable biomolecules. The findings contribute to the development of sustainable solutions for waste treatment and bio-product generation in the dairy industry.