

Oral Communication 2

Co-Exposure to Microplastics and Parabens: Implications for *Chlorella vulgaris* Bioremediation Efficiency

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Abstract

Background: Microplastics (MPs) are pervasive contaminants in aquatic systems and wastewater (WW), with polystyrene microplastics (PS-MPs) posing significant ecotoxicological risks [1]. MPs can also act as carriers for emerging contaminants [2], such as parabens—widely used preservatives frequently detected in WW [3]. Their co-occurrence raises concerns about combined effects on treatment efficiency and ecosystem health. **Objective:** This study evaluated the individual and combined effects of PS-MPs and methylparaben (MetP) on the physiological responses and bioremediation performance of *Chlorella vulgaris* in synthetic WW. **Methods:** *C. vulgaris* was exposed to 100 mg PS-MPs/L [4] and MetP (0.796 mg/L, [3]), individually and in co-exposure, under controlled growth conditions for 168 h. Microalgal growth, metabolic activity, nutrient removal, and contaminant fate were assessed. Adsorption assays were also performed to evaluate interactions between PS-MPs and MetP. **Results:** Short-term exposure (72 h) impaired metabolic activity and increased intracellular reactive oxygen species production. However, after 168 h, *C. vulgaris* recovered metabolic function, indicating potential activation of adaptive defense mechanisms. PS-MPs caused moderate growth inhibition (14%), while MetP alone or combined with PS-MPs did not significantly affect microalgal growth. Despite physiological stress, nutrient removal remained high, with nitrogen removal up to 80% and phosphorus removal between 63–70%. Also, *C. vulgaris* removed $21.34 \pm 1.12\%$ of MetP, which increased to $26.20 \pm 4.44\%$ in the presence of PS-MPs, suggesting a vector effect. The adsorption assays showed that PS-MPs retained 0.61 ± 0.05 mg MetP per g, enhancing its bioavailability, while no significant PS-MPs degradation occurred over 168 h, by the microalga. **Conclusions:** Overall, *C. vulgaris* demonstrated resilience under combined contaminant exposure, maintaining WW treatment performance and partially removing organic micropollutants. The interaction between PS-MPs and MetP enhanced contaminant uptake, highlighting the role of MPs as vectors for ECs. These findings support the potential of microalgal systems as eco-efficient solutions for treating WW contaminated with MPs and co-occurring pollutants.

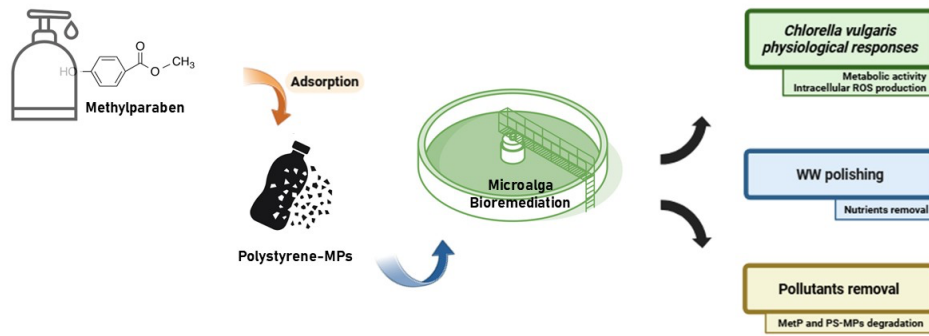


Figure 1. Physiological responses and bioremediation efficiency of *C. vulgaris* under individual and combined exposure to 100 mg PS-MPs/L and 0.796 mg MetP/L, under WW-mimicking conditions.

Keywords: microalgae-based systems; emerging contaminants; wastewater bioremediation

Acknowledgments/Funding

This work was supported by national funds through FCT/MECI: LEPABE, UID/00511/2025 (<https://doi.org/10.54499/UID/00511/2025>) and UID/PRR/00511/2025 (<https://doi.org/10.54499/UID/PRR/00511/2025>), and ALiCE, LA/P/0045/2020 (<https://doi.org/10.54499/LA/P/0045/2020>); the grant attributed by Portuguese Foundation for Science and Technology, I.P. – FCT – to Paulo Sousa by project reference 2022.14159.BD and DOI:10.54499/2022.14159.BD.

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