Photo anaerobic model 2: a mechanistic model for resource recovery using enriched purple phototrophic bacteria grown outdoors

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Introduction

- Purple phototrophic bacteria (PPB) are a promising option for resource recovery from wastewater
- The single model that exists to represent wastewater treatment and nutrient recovery by PPB does not consider other microbial clades, variable environmental conditions, or light attenuation
- A comprehensive mechanistic model applicable for PPB-enriched cultures grown outdoors is proposed

Model development

PAnM (Puyol et al. 2017): PPB single-clade model including PPB phototrophic and fermentative capabilities

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Other relevant microbial clades (aerobes, acidogens, acetogens, S-reducing bacteria, microalgae, predators)

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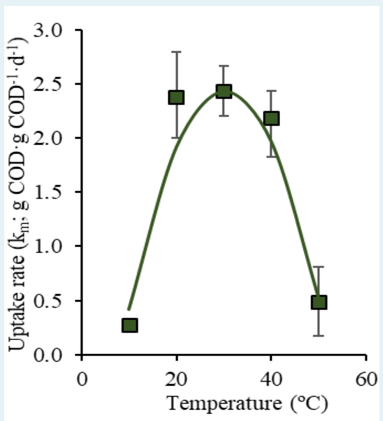
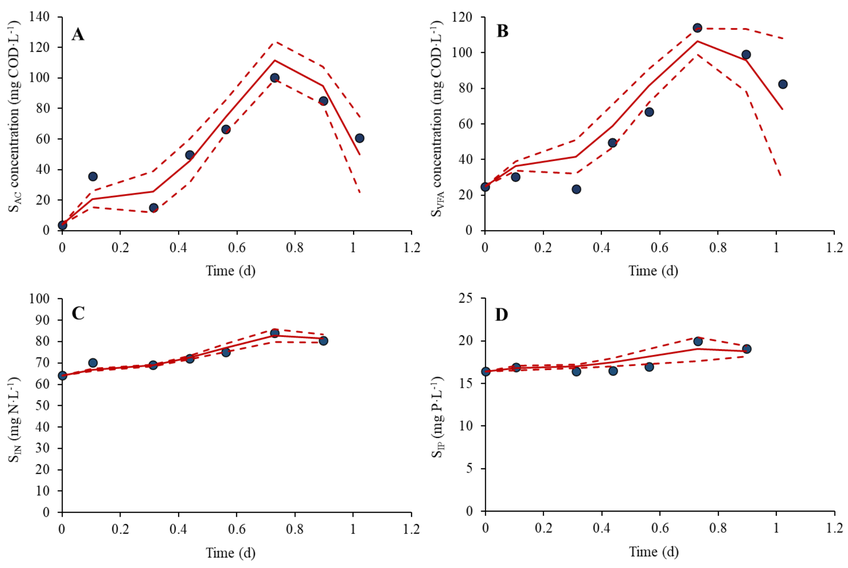
Batch tests to assess environmental factors: temperature, light intensity and light attenuation



Model calibration

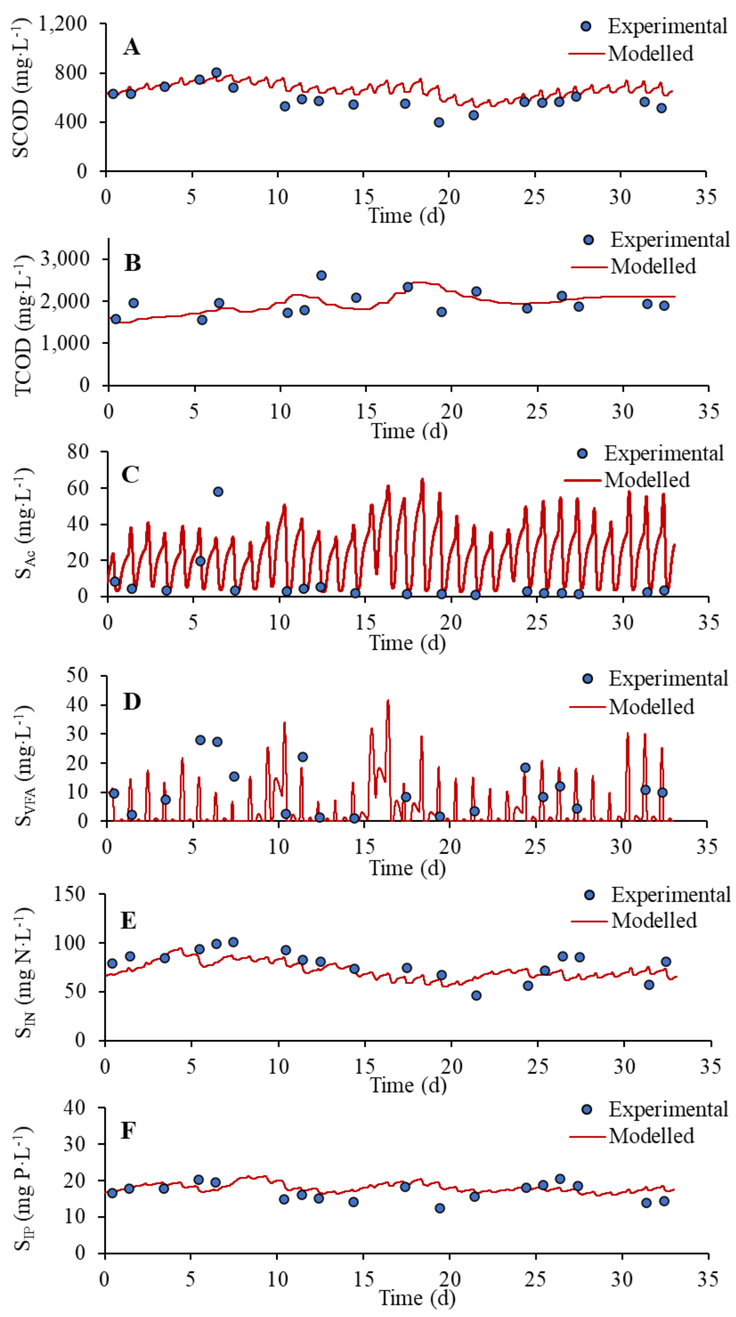
Data from an outdoors 10 m demonstration-scale flat plate photobioreactor (daily cycle study)



Calibration results for (A) acetate (S_{Ac}), (B) other VFA (S_{VFA}), (C) inorganic N (S_{IN}), and (D) inorganic P (S_{IP})

Model validation

Long-term data from an outdoors demonstration scale flat plate reactor



Validation results for (A) soluble COD (SCOD), (B) total COD (TCOD), (C) acetate (S_{Ac}), (D) other VFA (S_{VFA}), (E) inorganic N (S_{IN}), and (F) inorganic P (S_{IP})

Conclusions

- The selected functions represented properly the impact of environmental conditions on PPB growth and light attenuation
- The calibrated model represented accurately the dynamics in the outdoors photobioreactor, as well as the microbial communities
- The model was able to predict the daily kinetics of VFA production-consumption

Puyol, D., Barry, E.M., Hülsen, T., Batstone, D.J., 2017. A mechanistic model for anaerobic phototrophs in domestic wastewater applications: Photo-anaerobic model (PAnM). Water Res. 116, 241–253
Capson-Tojo, G., Batstone, D.J., Grassino, M., Vlaeminck, S.E., Puyol, D., Verstraete, W., Kleerebezem, R., Oehmen, A., Ghimire, A., Pikaar, I., Lema, J.M., Hülsen, T., 2020. *Purple phototrophic bacteria for resource recovery: Challenges and opportunities*. Biotechnol. Adv. 43, 107567