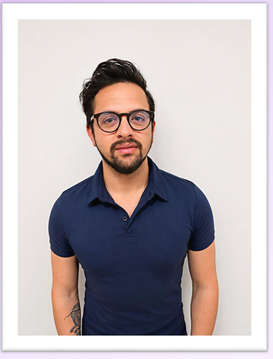

13th Internation Conference on Sustainable Solids Waste Management KOS 2026

Fractional valorization of purple phototrophic bacteria biomass grown in urban wastewater: comparison with waste activated sludge

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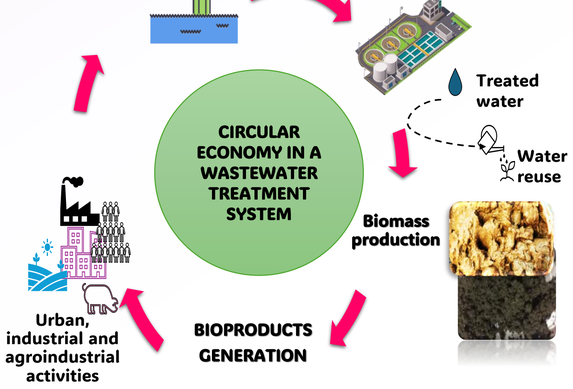
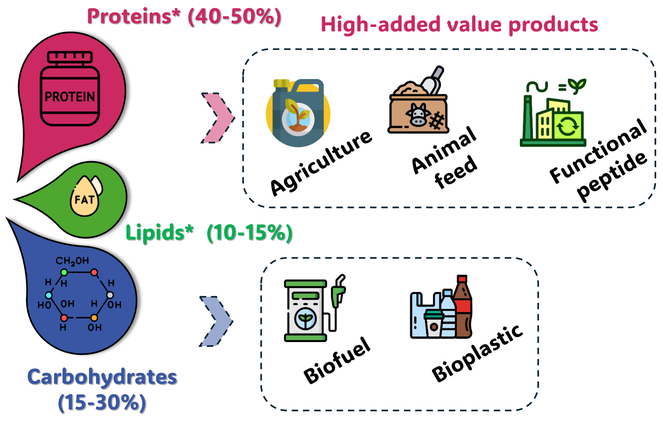
Introduction

Increasing urbanization, industrialization and unsustainable consumption patterns have led to an increase in the volume of wastewater (WW) to be treated. According to the European Environment Agency, 108,85 million m³ of WW will be produced in Europe between 2019-2020.



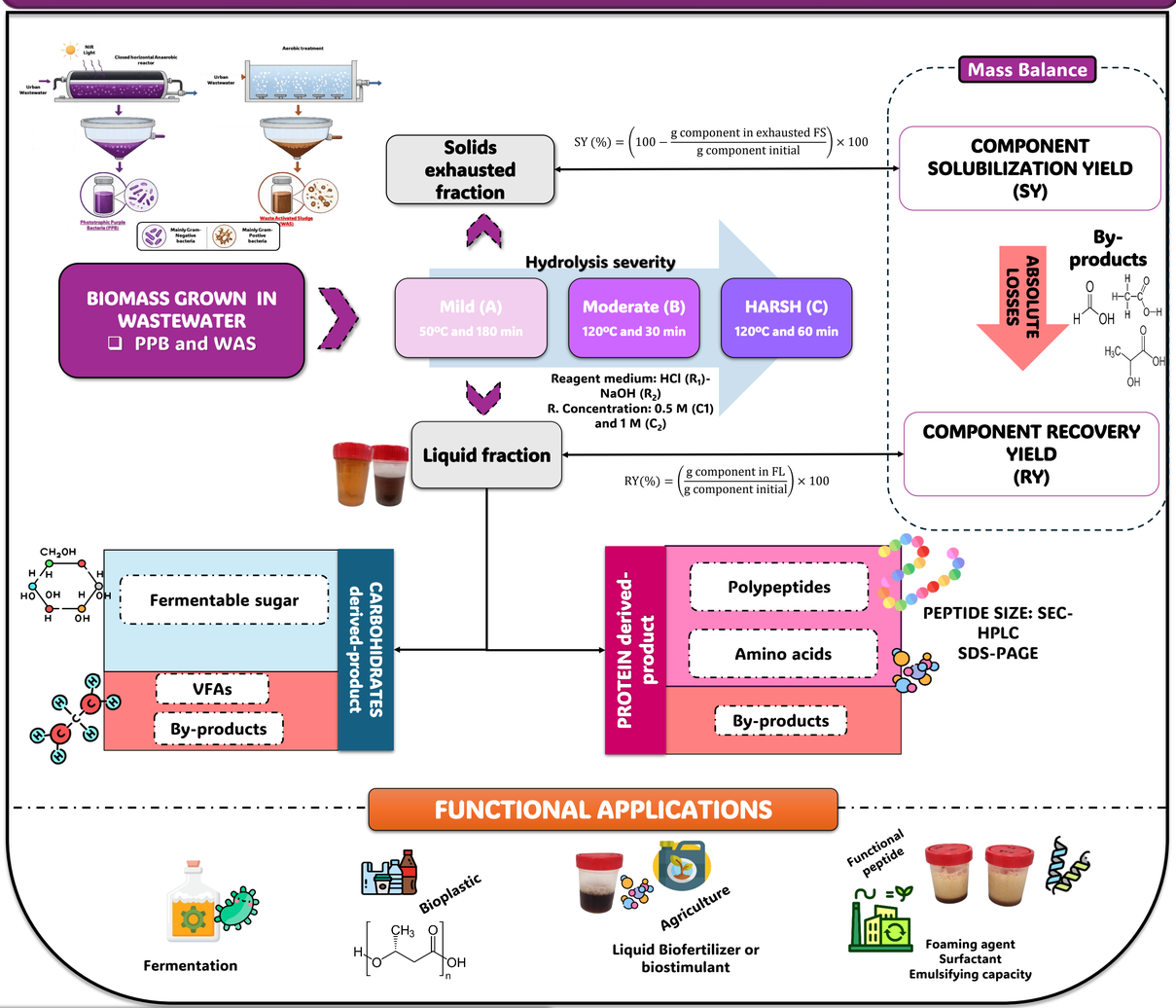
Wastewater treatment using purple phototrophic bacteria (PPB) has emerged as a sustainable alternative to conventional activated sludge systems. PPB grow photoheterotrophically under anaerobic conditions using near-infrared (NIR) light as an energy source, thereby reducing the energy demand associated with aeration.



Parameter	Conventional aerobic system	PPB-based system
COD removal	85–95 %	80–95 %
Nitrogen removal	70–90 %	40–85 %
Phosphorus removal	70–95 %	50–90 %
Biomass productivity (gCOD/gCOD removed)	0.35–0.65	0.60–0.95
Energy consumption	High (aeration required)	Low (no aeration, NIR light as energy source)
Biomass value	High	High

Owing to their high metabolic flexibility, PPB can efficiently treat wastewaters (WW) with high organic loads while producing a biomass rich, mainly in proteins (≈40–50%) and carbohydrates (20–25%). Current valorization approaches mainly focus on the direct use of this biomass as single-cell protein (SCP) for animal feed or as a biofertilizer. However, these applications often require additional sanitation steps and do not fully exploit the potential of the biomass. In contrast, the fractionation and targeted recovery of individual components (e.g., peptides and fermentable sugar) may provide greater economic and environmental benefits within a biorefinery framework .

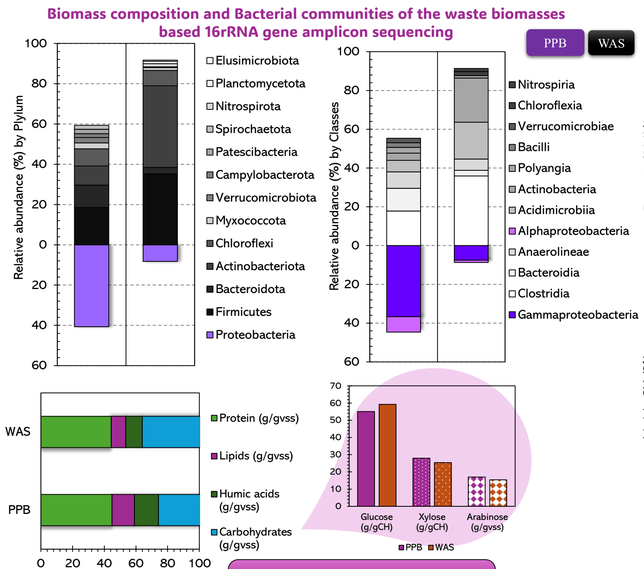
Material and Method



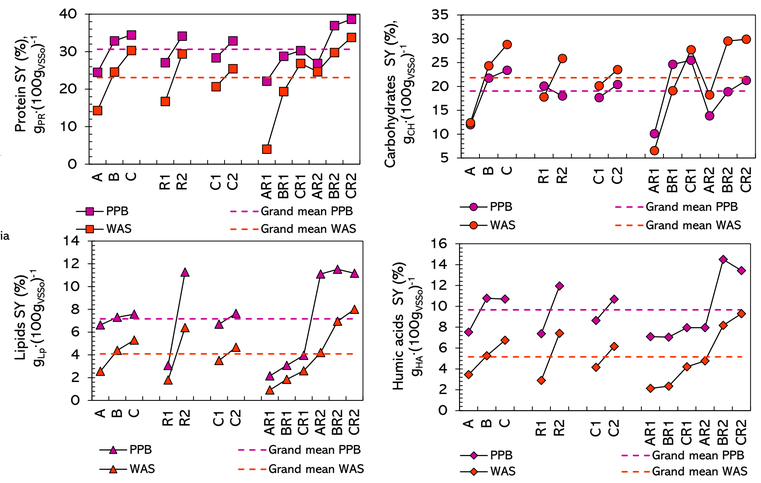
RESULTS and CONCLUSION

EFFECT OF HYDROLYSIS SEVERITY ON GLOBAL BIOMASS AND INDIVIDUAL COMPONENT SOLUBILIZATION

Biomass composition and Bacterial communities of the waste biomasses based 16rRNA gene amplicon sequencing

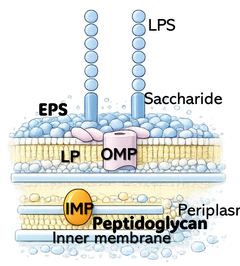


Main effect plot on component solubilizations



Phototrophic Purple Bacteria (PPB)

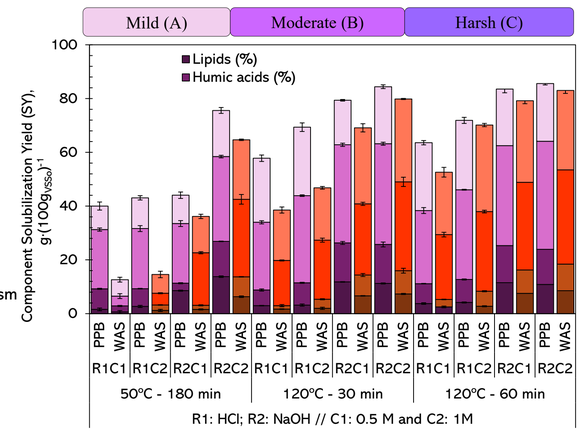
72% Gram-negative bacteria
High microbial diversity



❑Low mechanical resistance
❑Lipid-rich envelope

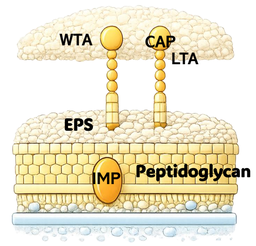
Soft/Moderate severity

50ºC-180 min
-or-
120ºC – 30 min
NaOH or HCl



Waste Activated Sludge (WAS)

76% Gram-positive bacteria
EPS-rich floc structure



❑Hight structural regidity

Harsh severity

120ºC – 60 min
NaOH preferred

Cell wall architecture and EPS organizations governs hydrolysis efficiency

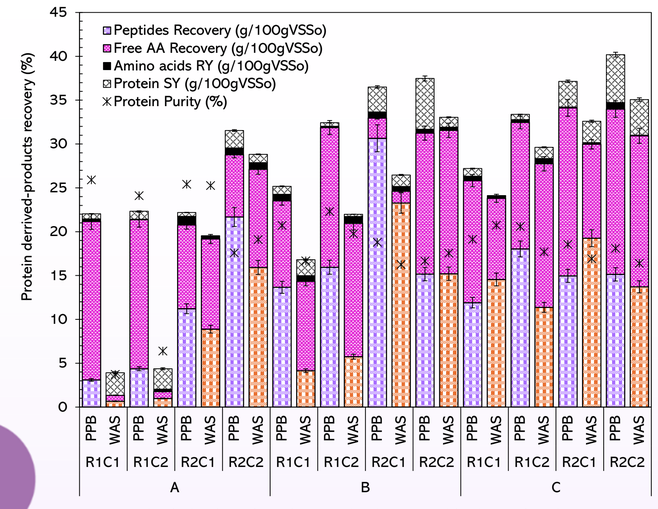
Gram⁻ thin PG → fast disruption
Gram⁺ thick PG + EPS → recalcitran biomass

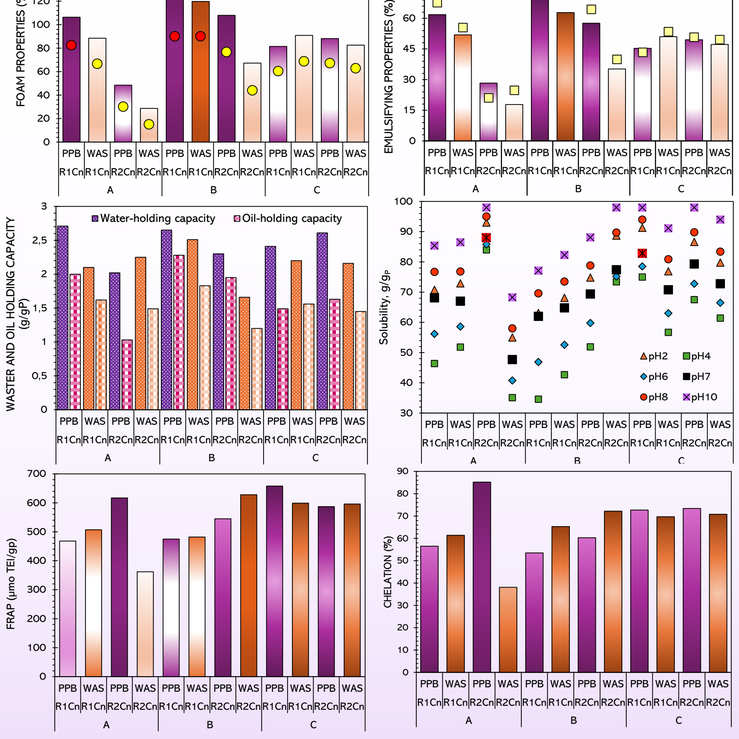
PROTEIN DERIVED-PRODUCTS FRACTION

EFFECT OF HYDROLYSIS SEVERITY ON RECOVERY OF VALUE-ADDED MACROCOMPONENTS

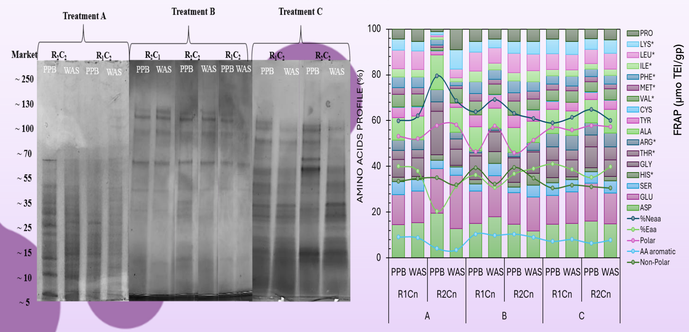
CARBOHYDRATES DERIVED-PRODUCTS FRACTION

FUNCTIONAL PROPERTIES





Protein-derived product characterizations: Peptide size and Amino acids Profile



PPB Highlights

- Highest overall multifunctionality
- B-R1: best emulsification and foaming
- C-R1: best antioxidant and chelation
- A-R2: highest solubility and free amino acids

WAS Highlights

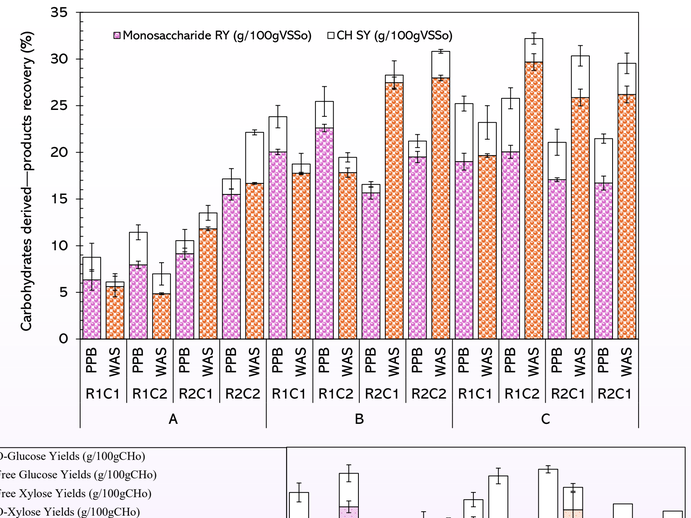
- Frequently within ±10% of PPB
- B-R1 ≈ PPB for interfacial properties
- C-R1≈ PPB for bioactive properties
- Requires stronger hydrolysis to match PPB

PPB Highlights

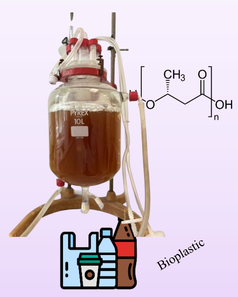
A–R2C2: 56.0% carbohydrates
B–R1C2: Maximum carbohydrates recovery (81.7% CH) as free glucosa (62.8%)
B–R1C1: Maximum xylose recovery (80.3% Xo).

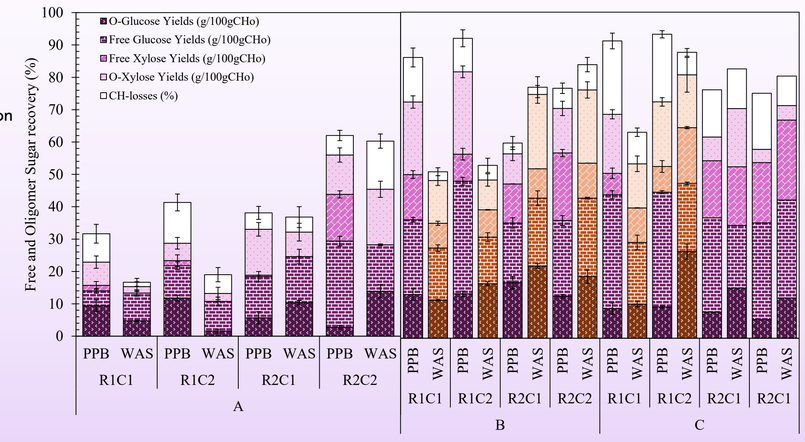
WAS Highlights

A–R2C2: 45.4% carbohydrate recovery. **C–R1C2:** Maximum carbohydrate recovery (80.8% CH).
C–R1C2: Balanced glucose and xylose recovery (80.2% Go; 81.6% Xo).
C–R2C1: Highest xylose recovery (87.9% Xo).



Fermentable sugar-rich hydrolysates are ideal for Bioethanol, Lactic acid, and Polyhydroxyalkanoates production





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