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Probiotics derived from circular feedstock via lactic acid bacteria and yeast cultivation

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BIOENERGY & BIOPRODUCTS

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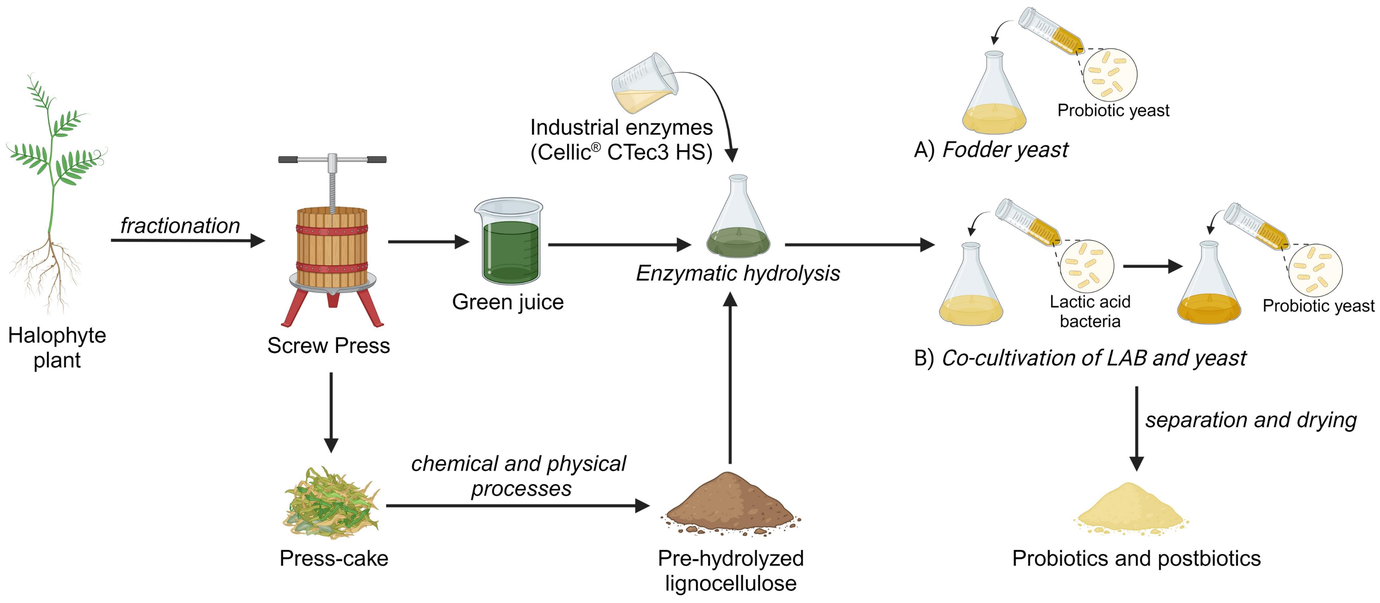
INTRODUCTION

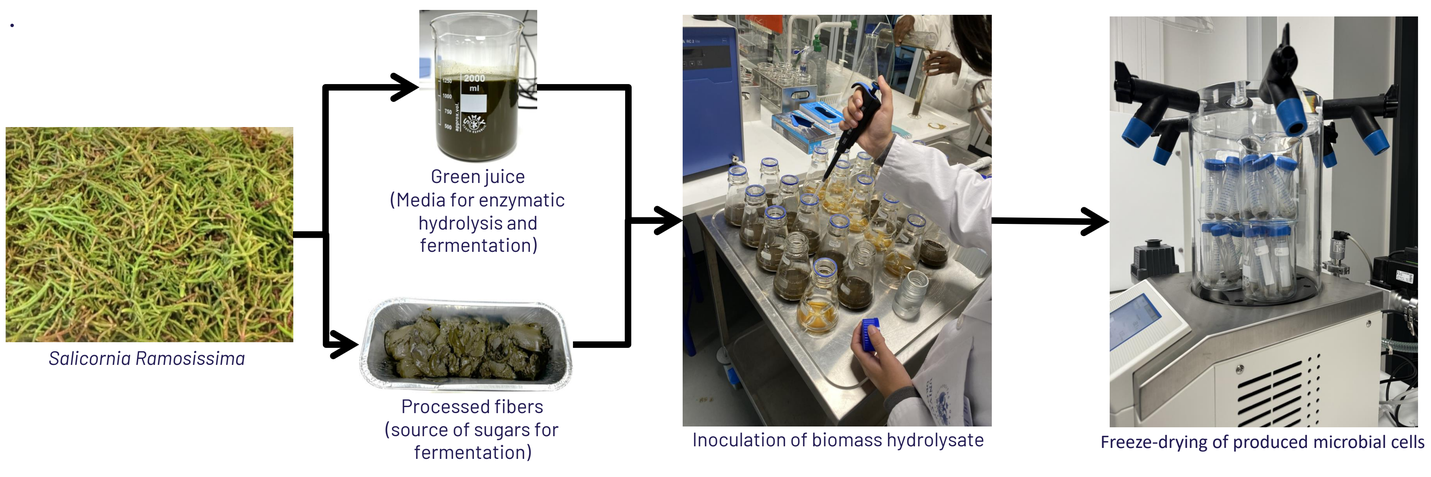
- Halophytes are emerging as supercrops due to their diversity and ability to adapt to challenging environments. They are especially suitable for **cultivation in marginal lands** [1] and can be used for the **phytoremediation of salt-affected soils** [2]. Additionally, halophytes show promise in helping with **CO2 capture** [3].
- These plants are rich in **high-value bioactive compounds** such as **phenolics, carotenoids, and vitamins** [4]. A **halophyte-based biorefinery** aims to extract these valuable compounds.
- The leftover **green juice** from processing can be **used as a medium for enzymatic hydrolysis and fermentation**. The remaining **lignocellulosic fibers** can also be **saccharified and fermented with probiotic bacteria and yeast** to produce **functional animal feed**.

Overall, commercializing halophytes could greatly enhance soil quality, prevent further soil degradation, and take advantage of their natural carbon sequestration properties while also leading to the production of high-value compounds and functional feed.

Halophyte-based biorefinery



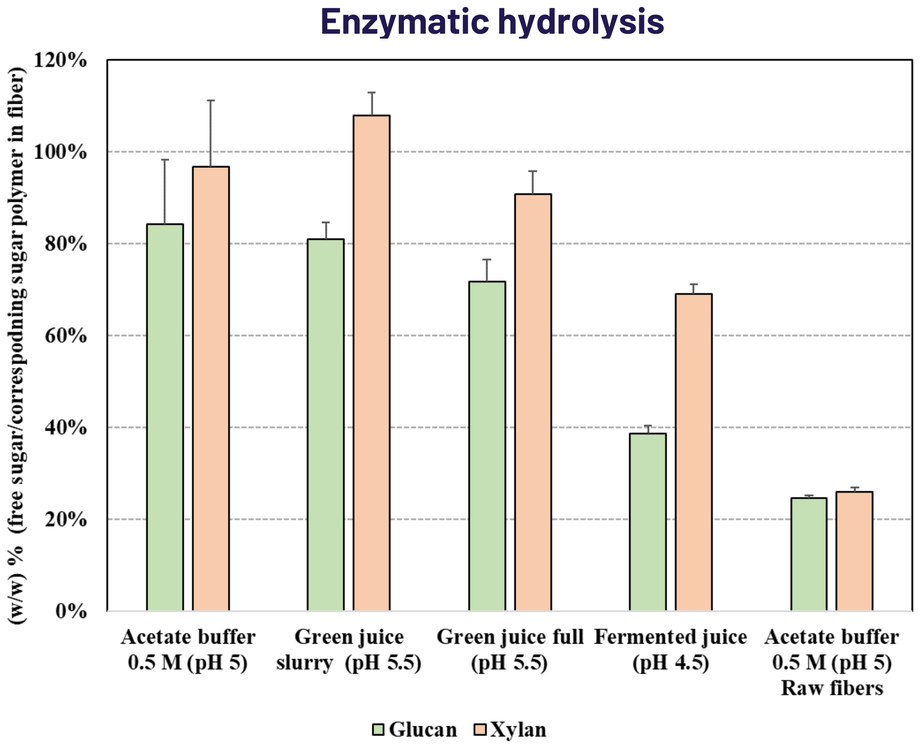
EXPERIMENTAL SET UP



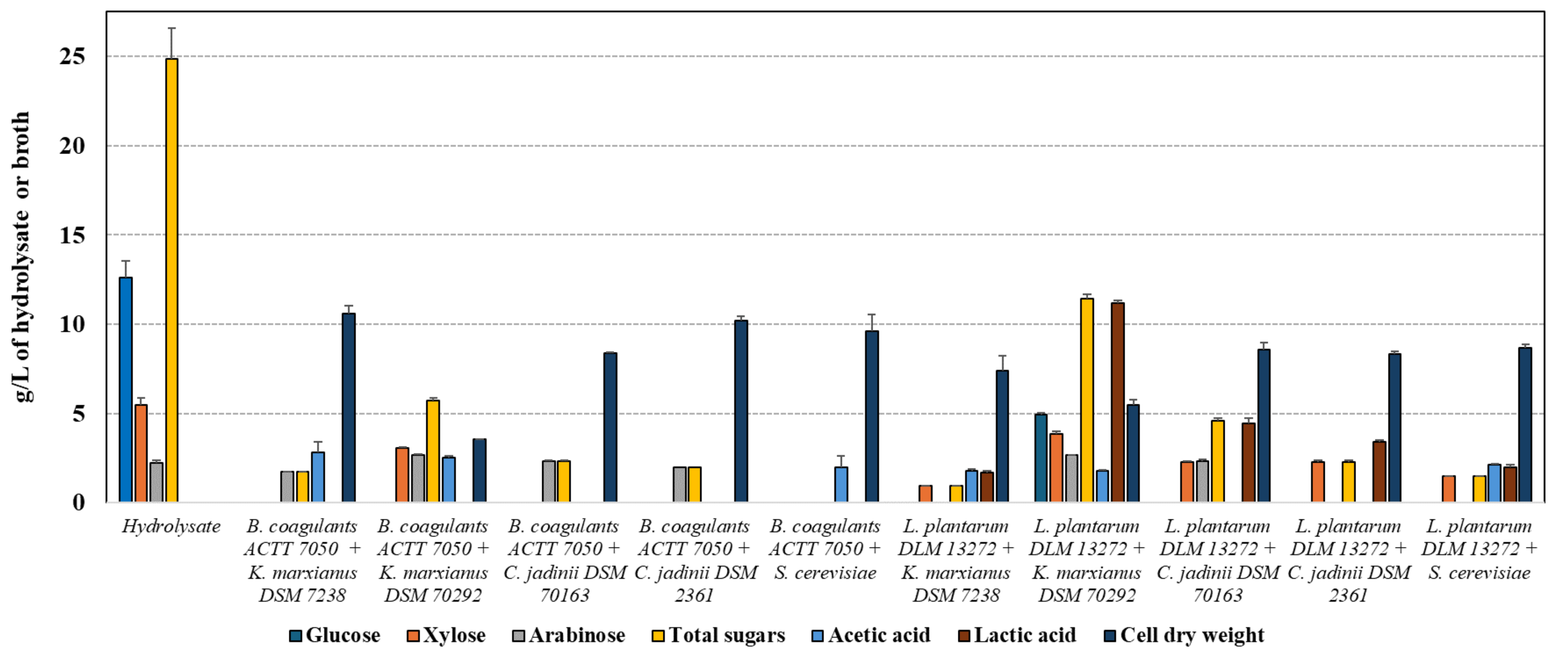
- Cultures: *Lactobacillus plantarum* DSM 13272, *Bacillus coagulants* ACTT 7050, *Kluyveromyces marxianus* DSM 7238, *K. marxianus* DSM 70292, *Cyberlindnera jadinii* DSM 70163, *C. jadinii* DSM 2361, *Yarrowia lipolytica* DSM 8218, *Saccharomyces cerevisiae* (commercial dry yeast, Malteserkors tørgær)
- Enzymes: Cellic® CTec3 HS (Novozymes A/S)
- Plant material: *Salicornia Ramosissima* harvested in Portugal in October 2023 and fractioned at Aarhus University, Foulum, Denmark.
- Analytical tools: CHNS elemental analyzer (Pekin Elmer 2400 series CHNS/O), HPLC (1260 Infinity II, Agilent Technologies), Bio-Rad Aminex HPX-87H Column (Rio-Rad Laboratories Inc.), (InfinityLab Poroshell 120 EC-C18, Agilent Technologies, Inc.)

RESULTS

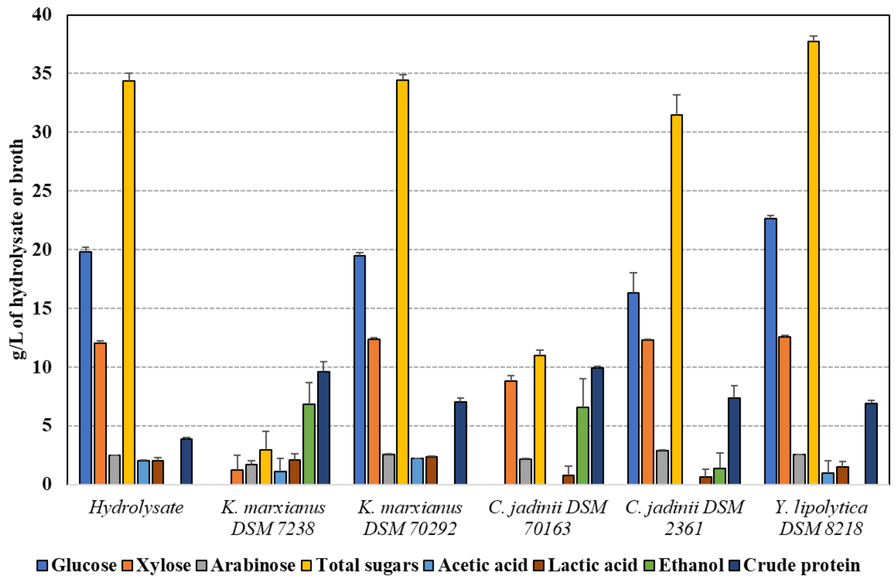
Enzymatic hydrolysis



Co-cultivation of LAB and yeast



Yeast cultivation



Microbial Sequencing

CONCLUSION

- Halophyte green juice has proven to be an excellent medium for enzymatic hydrolysis, reaching a sugar concentration of 30 to 55 g of sugars/L
- Hydrolysate based on green juice and pre-treated fibers showed mixed results as a growth medium for yeast cultivation
- Co-cultivation of probiotic bacteria and yeast demonstrated a significant improvement in carbon source utilization and cell mass formation. Additionally, co-cultivation exhibited contamination control properties due to its ability to suppress other microbial communities present in halophyte juice
- Overall, halophytes as circular plants have much to offer, as demonstrated by their potential to be upcycled into probiotics and other healthy, sustainable products.

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