RHODES 2024: Waste streams for sustainable generation of bioplastic precursors through targeted acidogenic fermentation

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Keywords: acidogenic microorganisms, organic waste, PHA, VFA, volatile fatty acids

Introduction

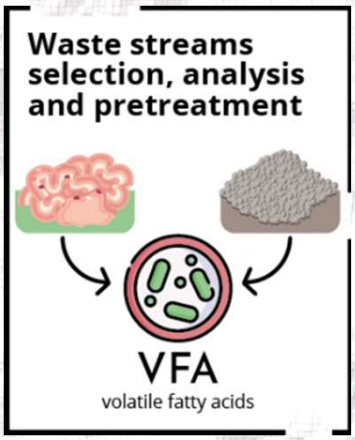
The utilization of heterogenous waste materials - ranging from agricultural residues to industrial by-products - as precursors for the production of Volatile Fatty Acids (VFAs) has garnered attention in the context of sustainable bioproduction.

The ELLIPSE project investigates into the complexities of directed acidogenic fermentation, highlighting the significance of thoughtful waste stream selection, specific process conditions, and potential pre-treatments to enhance efficiency.

The ELLIPSE approach to VFA, bioplastics and fertilizers

Waste selection

The ELLIPSE project focuses on the valorization of selected waste streams from the **pulp and paper** industry, **slaughterhouses**, and sludge, to generate cost-effective biodegradable bioplastics.



Operational strategy

The primary objective revolves around maximizing propionic and valeric acid production during the initial acidogenic fermentation stage; hence, the necessity arises for **targeted acidogenesis**. This strategic approach seeks to use these VFAs as substrates for the subsequent bioplastics production.

Closing circles

A controlled-release fertilizer formulation will utilize nitrogen and phosphorus recovered from the side-streams.

Preliminary insights

Acidogenic fermentation tests were conducted to assess VFA production feasibility from target waste streams.

- Trials were carried out at 38°C in 2L glass bioreactors.
- pH of the trials was adjusted to either acidic (pH 5.5) or alkaline (pH 10) conditions to evaluate VFA production efficiency and composition.
- Parameters evaluated were: pH, temperature, organic loading rate, and waste composition.

Preliminary conclusions

- Results showed higher VFA concentrations under basic pH conditions.
- Acetic, propionic, and butyric acids predominated under both pH conditions.
- Protein-rich substrates favor propionic acid at low pH, acetic acid at medium pH.
- pH and waste composition influence volatile fatty acid outcomes significantly.
- Organic loading rate and retention time shape microbial communities and acid distributions.
- Balancing organic loading rate is essential for effective microbial regulation.
- Findings align with similar acidogenic fermentation studies, demonstrating potential for VFA production from the studied waste streams.

Funded by the European Union under grant agreement N 101112581 (Efficient and novel waste streams co-processing to obtain bio-based solutions for packaging and agricultural sectors - ELLIPSE project). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CBE JU. Neither the European Union nor the CBE JU can be held responsible for them.