# Designing mixed-culture bioprocesses by means of bioenergetics models

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## BIOCHEM project: Designing mixed-culture processes for a circular economy

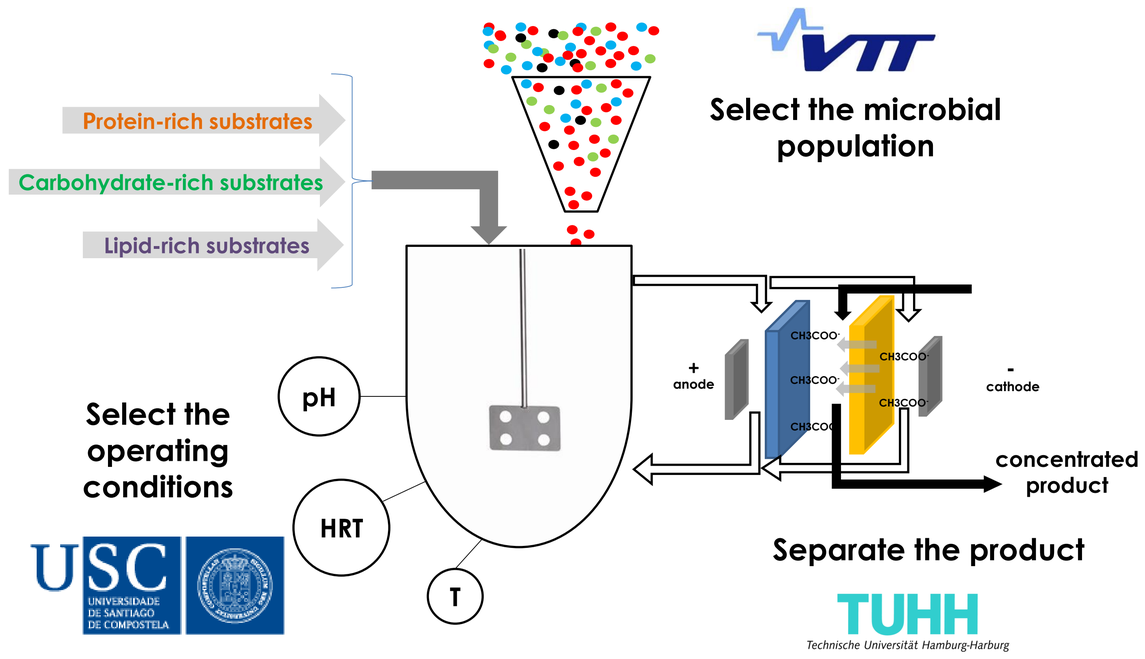
### Mixed culture processes

+ Pros — Cons −

| | |
|---|---|
| No sterilisation | Complex and not fully understood |
| Treat complex substrates | Very variable outcome |
| Robust | Novel bioprocesses are hard to design |

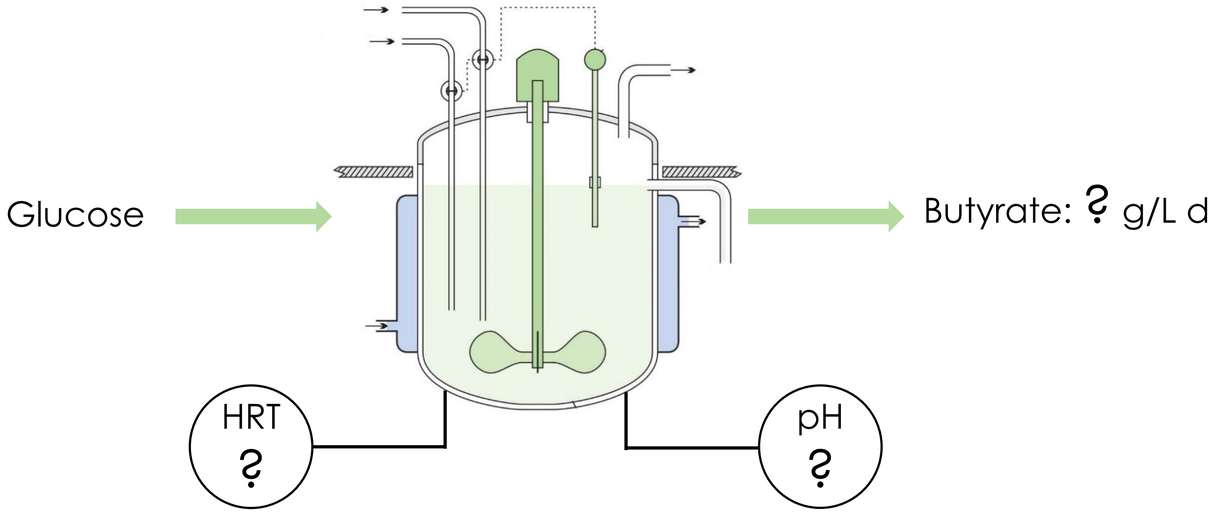
The design of a bioprocess that uses a mixed culture is a hard task. BIOCHEM tackles this issue with a special focus on the use of modelling tools.

### BIOCHEM APPROACH

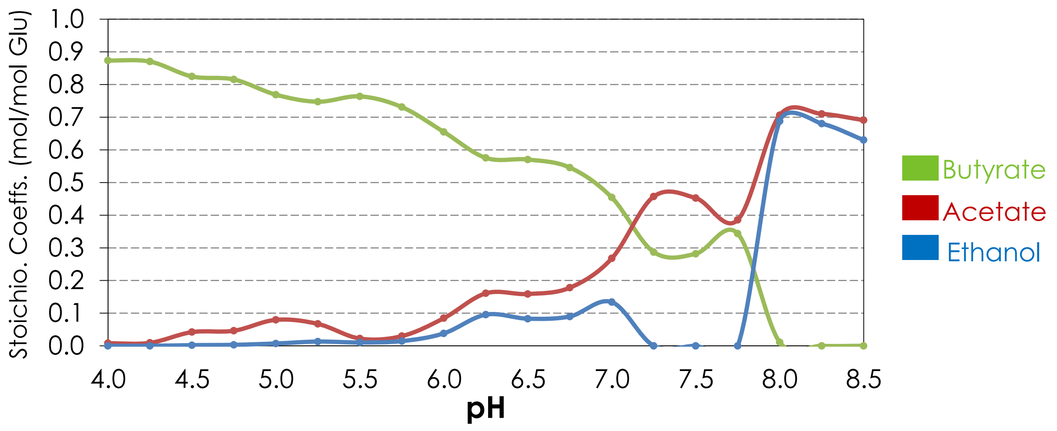



## USC: Selecting the operating conditions

Case study: to produce butyrate from a glucose-rich waste (4 g/L)

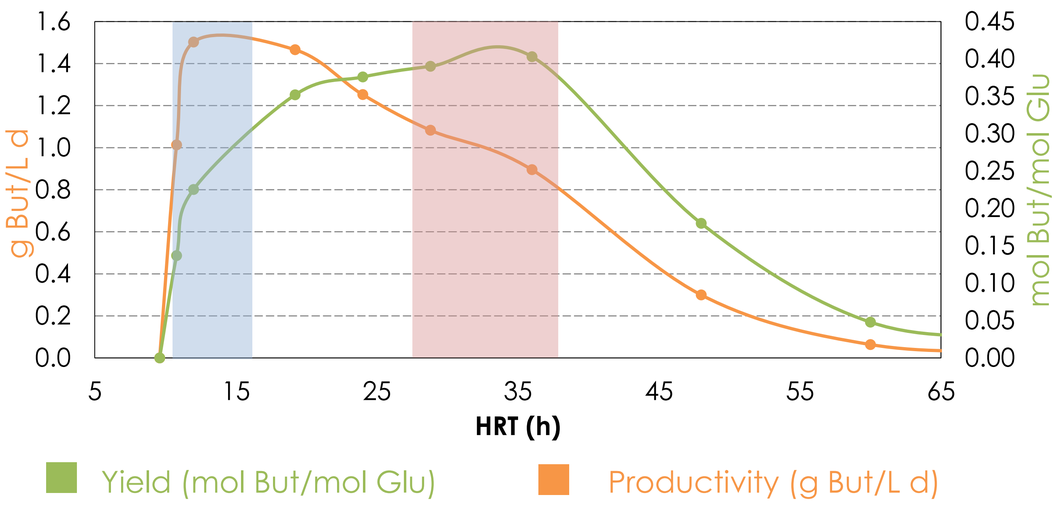



### ① Determine the stoichiometry and select the pH with the bioenergetics model




Results from the model suggest to select a pH≤5.5 to ensure a high **butyrate** stoichiometric coefficient.

### ② Select the HRT with the kinetic model




Two regions of interest arise from the simulation results:
: Maximum productivity. Interesting for very high added-value products
: Maximum yield. Appropriate for bulk chemicals and difficult-to-separate products **(butyrate)**.

**EARLY-STAGE DESIGN RESULTS**

| | |
|---|---|
| pH = 5.5 | HRT ≈ 35 h |
| Yield = 0.4 mol But/mol Glu | Productivity = 1 g But/L d |

## Future perspectives in BIOCHEM

- Including protein and lipids in our models for assessing complex substrates.
- To incorporate separation processes (e.g. In situ Product Recovery) in our modelling framework in collaboration with TUHH.
- The expected end result is a virtual plant for early stage simulation of mixed culture fermentations.

**References**

González-Cabaleiro *et al.* 2015. Metabolic Energy-Based Modelling Explains Product Yielding in Anaerobic Mixed Culture Fermentations. PLoS ONE, 10.
Batstone *et al.* 2002. The IWA Anaerobic Digestion Model No 1 (ADM1). Water Sci Technol, 10, 65-73.

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