Polyhydroxyalkanoates (PHA) production from crude glycerol

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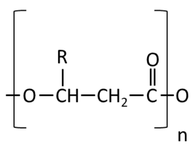
Polyhydroxyalkanoates (PHA)

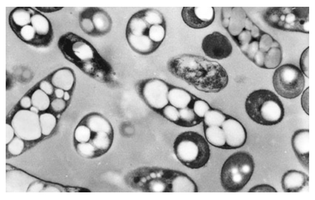
PHA are a family of bacterial polyesters.
The most common polymers are PHB and PHV.



R	
H	polyhydroxypropionate (PHP)
CH_3	polyhydroxybutyrate (PHB)
CH_2CH_3	polyhydroxyvalerate (PHV)

Copolymers P(HB-*co*-HV)

PHA are produced in microbial cells as a storage polymers in situations of unbalanced growth.



PHA inside of microbial cells
(source: www.bio-on.it)

PHA are biodegradable **bioplastics** with similar properties to PE and PP.

Biodegradable PHA bottles
(source: www.biobasedpress.eu)

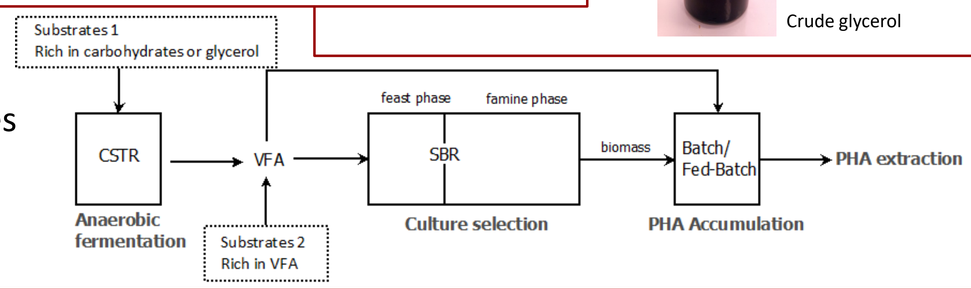
PHA can be produced from **renewable resources** and organic wastes.

The project aimed at the conversion of **crude glycerol**, a by-product of the bio-diesel industry.

Crude glycerol

PHA production in **Mixed Microbial Cultures** has three main steps:

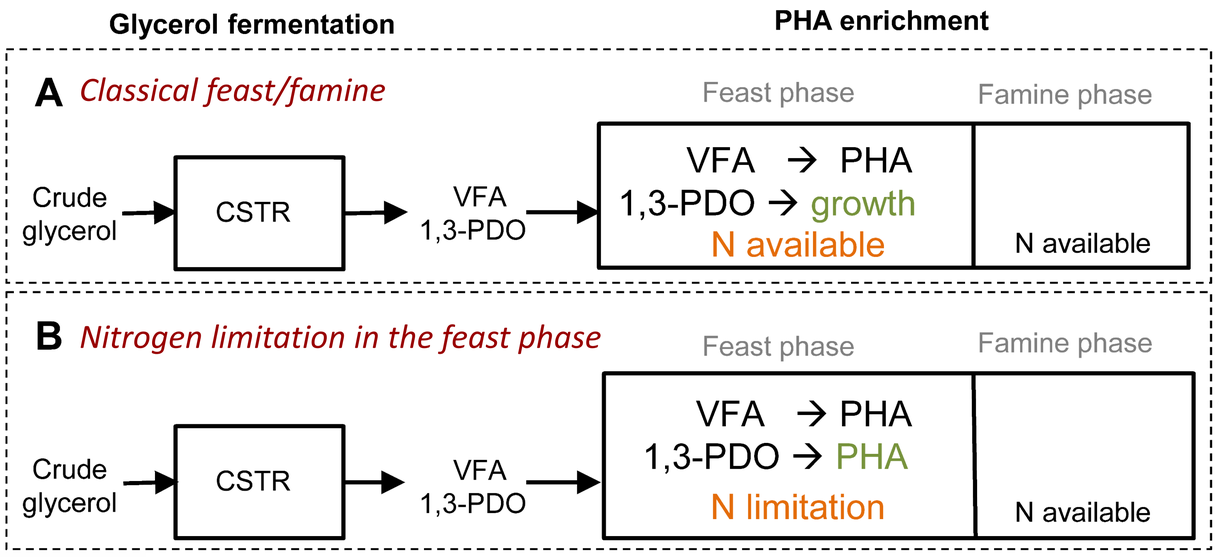
1) **Fermentation** of the substrate to volatile fatty acids (VFA), which are optimal substrates
2) **Enrichment** of a culture under unbalanced conditions (feast-famine cycles)
3) **PHA accumulation** under nutrient limiting conditions

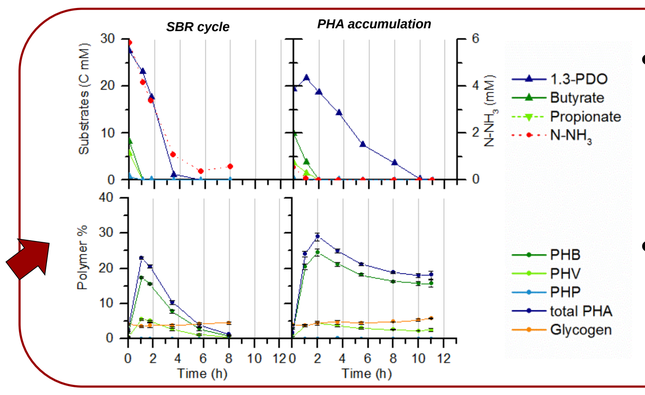


Strategies for PHA production from fermented crude glycerol

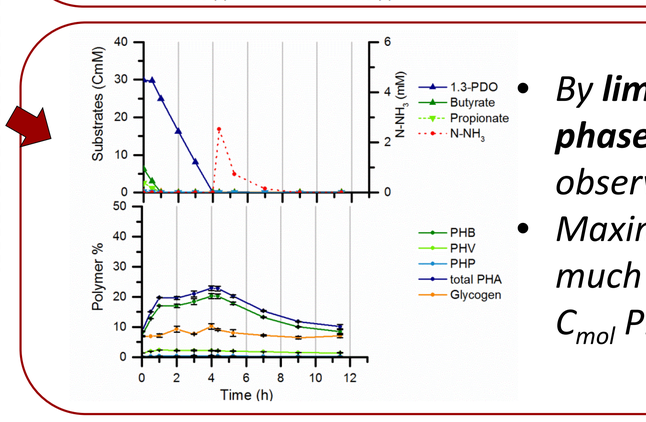
Strategy 1 - Conversion of VFA and 1,3-PDO to PHA – Nitrogen limitation during the feast phase

Can 1,3-propanediol (1,3-PDO) be converted to PHA?





- *Classical feast/famine enrichments are performed with nitrogen during the whole enrichment phase.*
- *This strategy did not lead to PHA production from 1,3-PDO during the accumulation phase.*

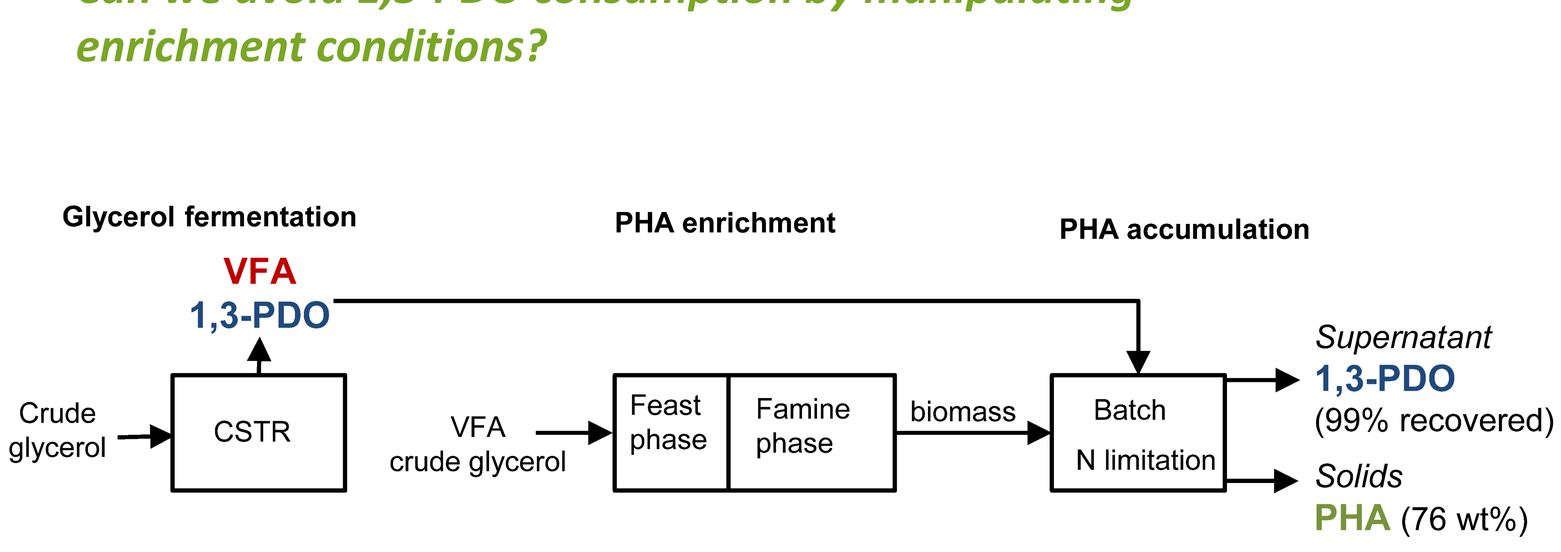


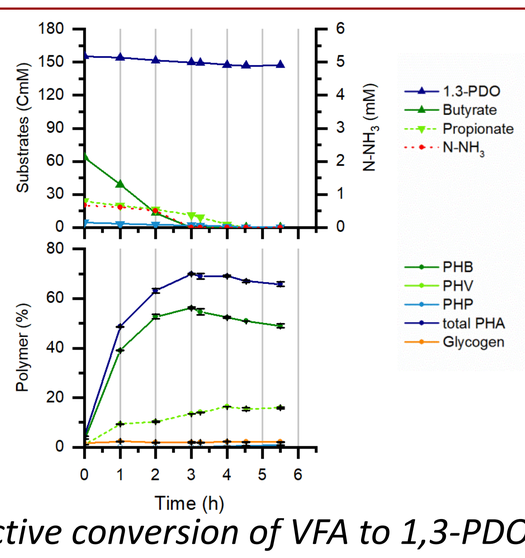
- ***By limiting the nitrogen during the feast phase, PHA production from 1,3-PDO*** *was observed.*
- *Maximum PHA yields from 1,3-PDO were much lower than from VFA (0.21 vs 0.74 C_{mol} PHA/C_{mol} Substrate, respectively).*

link to published article:
Burniol-Figols et al., Water research 128 (2018): 255-266.

Strategy 2 – Conversion of VFA to PHA with 1,3-PDO recovery

Can we avoid 1,3-PDO consumption by manipulating enrichment conditions?





- *Selective conversion of VFA to 1,3-PDO was attained by not supplying 1,3-PDO during the enrichment phase.*
- *PHA yield was 0.99 C_{mol} PHA/C_{mol} Substrate.*
- *The strategy converted a* ***fermentation by-product into PHA, a high value product.***
- *Potential to be applied to other biological fermentations.*

link to published article:
Burniol-Figols et al., Water research 136 (2018): 180-191.

Acknowledgements

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