

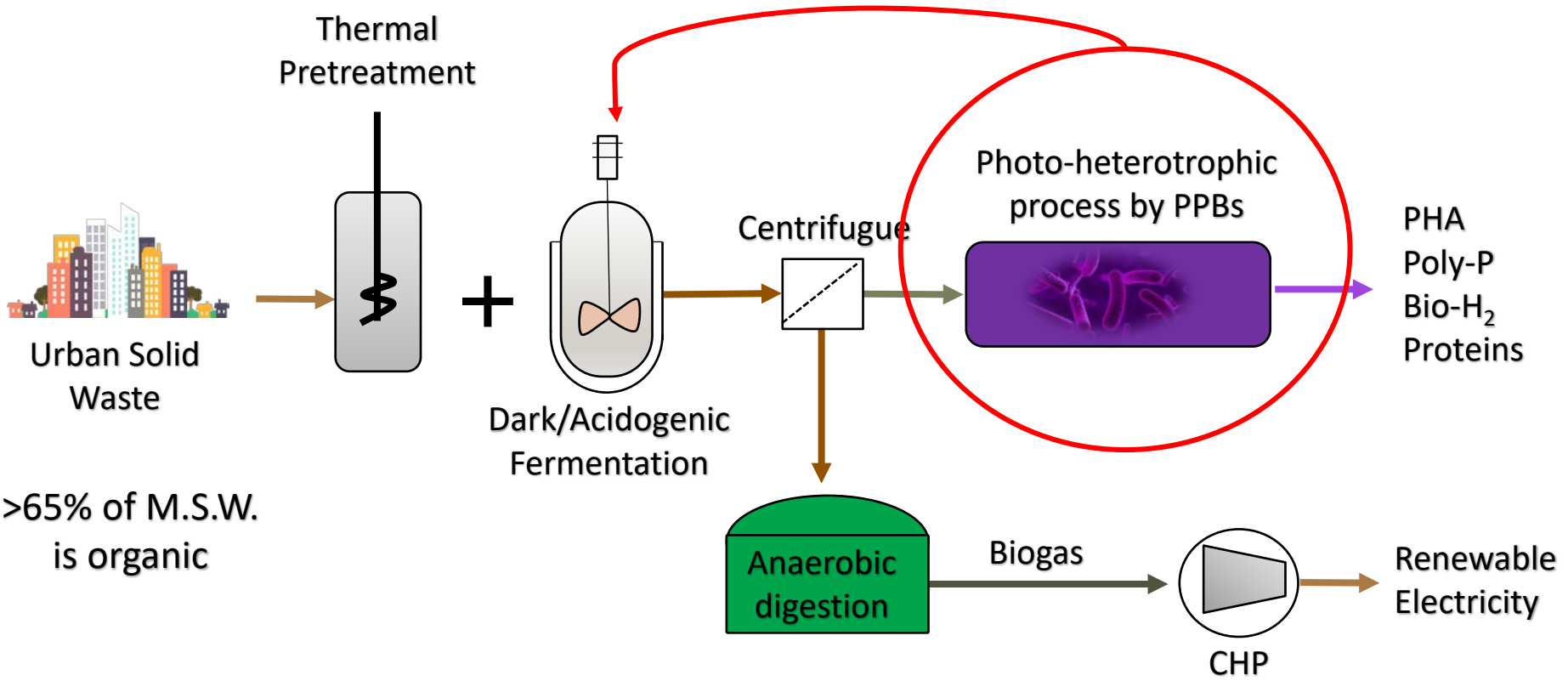
Maximizing PHA production from acetate, propionate and butyrate using Purple Phototrophic Bacteria

Luis D. Allegue, Maria Ventura, Daniel Puyol Santos, Juan A. Melero



Context

Photo-biorefinery

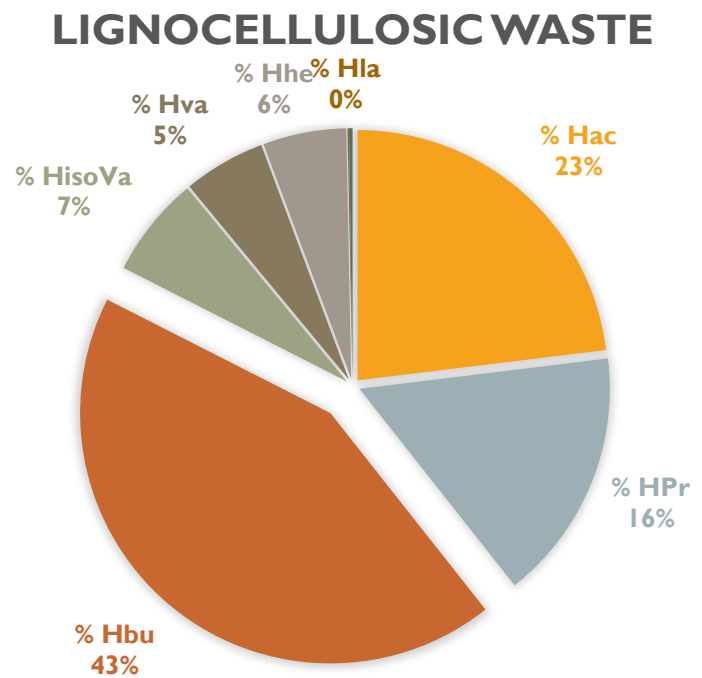
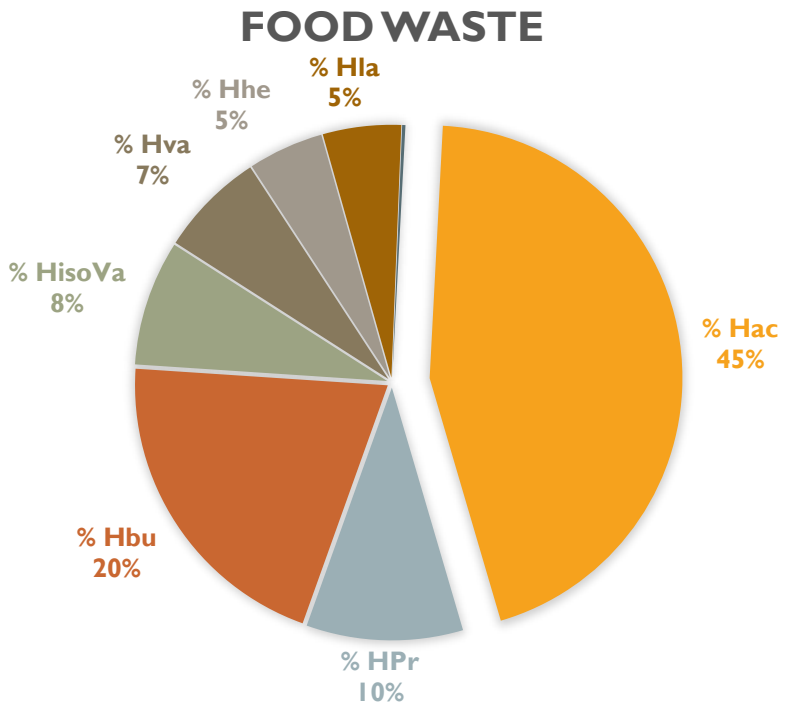


>65% of M.S.W. is organic

Context

Acidogenic fermentation

VFA composition obtained from batch thermophilic fermentation - pH: 5.5



Other strategies to selectively produce VFA: TRH, OLR, Temperature, pH, etc...

Methods and Materials

Photo-heterotrophic process



Different concentrations of:
Acetate – Propionate - Butyrate

Conditions

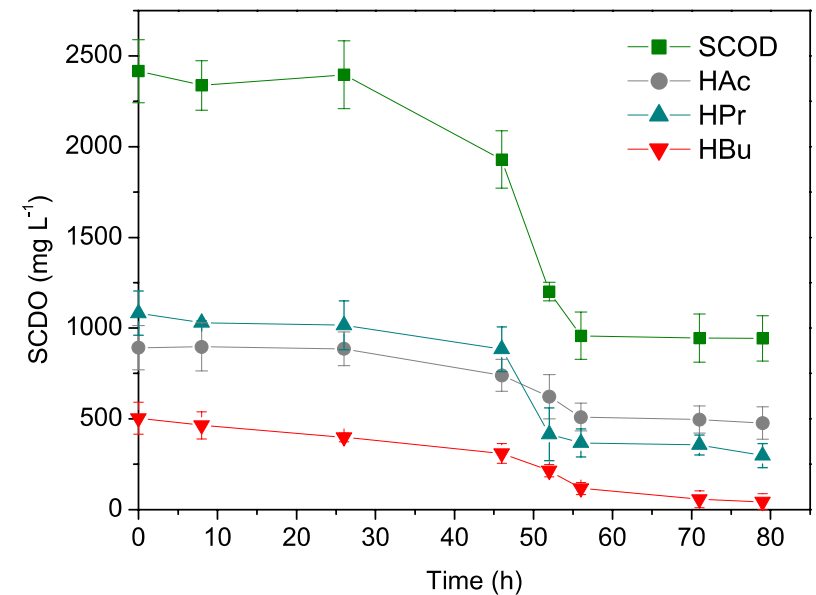
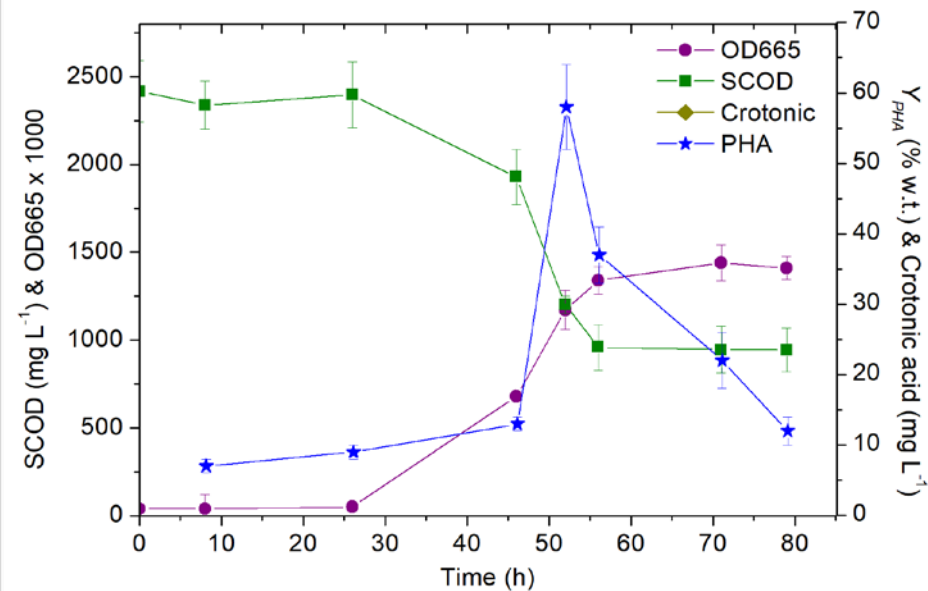
- ❖ 45 W m⁻² IR Light
- ❖ 30°C
- ❖ 1% volume of PPB inoculum
- ❖ Limited nitrogen and phosphorus

Acetate (mg L ⁻¹)	Propionate (mg L ⁻¹)	Butyrate (mg L ⁻¹)	Nutrient limitation
1	1	0.5	Yes - High
1	0.5	1	Yes - High
0.5	1	1	Yes - High
0.5	0.5	0.5	Yes
0.5	0.5	0.5	Yes
0.5	0.5	0.5	Yes
1	0	0.5	Yes
0	1	0.5	Yes
1	0.5	0	Yes
0	0.5	1	Yes
0.5	1	0	Yes
0.5	0	1	Yes
0	0	0.5	No
0	0.5	0	No
0.5	0	0	No

Results

Photo-heterotrophic process

Experiment: 1 g L⁻¹ Acetate + 1 g L⁻¹ Propionate + 0.5 g L⁻¹ Butyrate

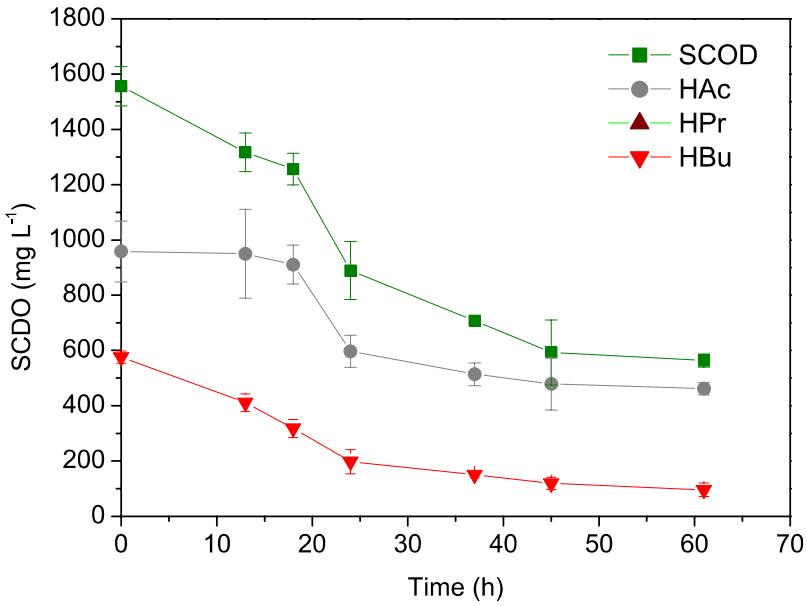
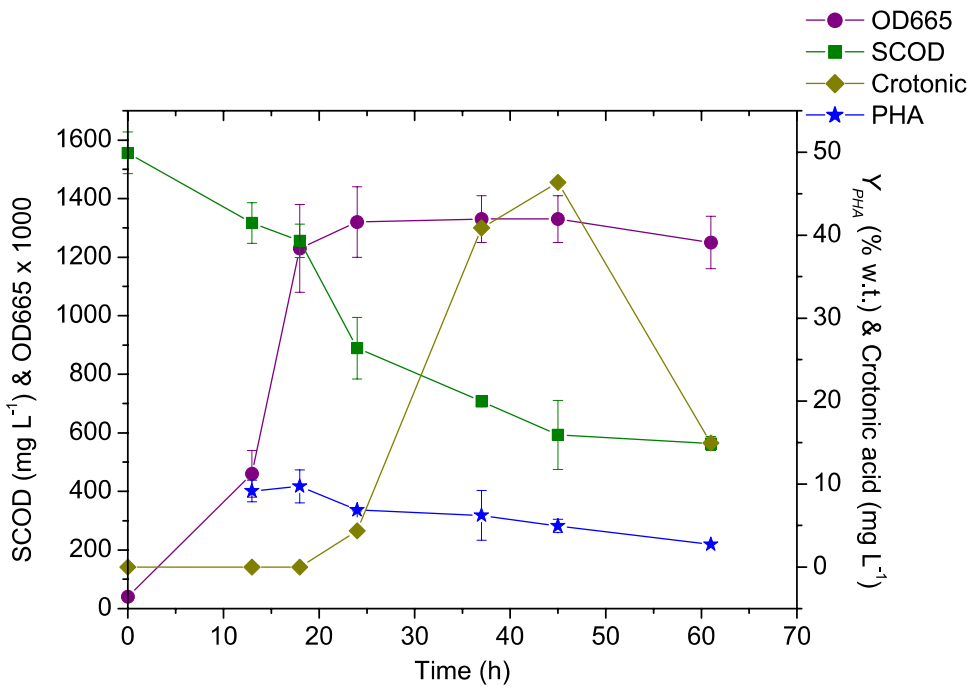


- 58% PHA produced
- Co-polymer P(3HB-3HV) (4%)

Results

Photo-heterotrophic process

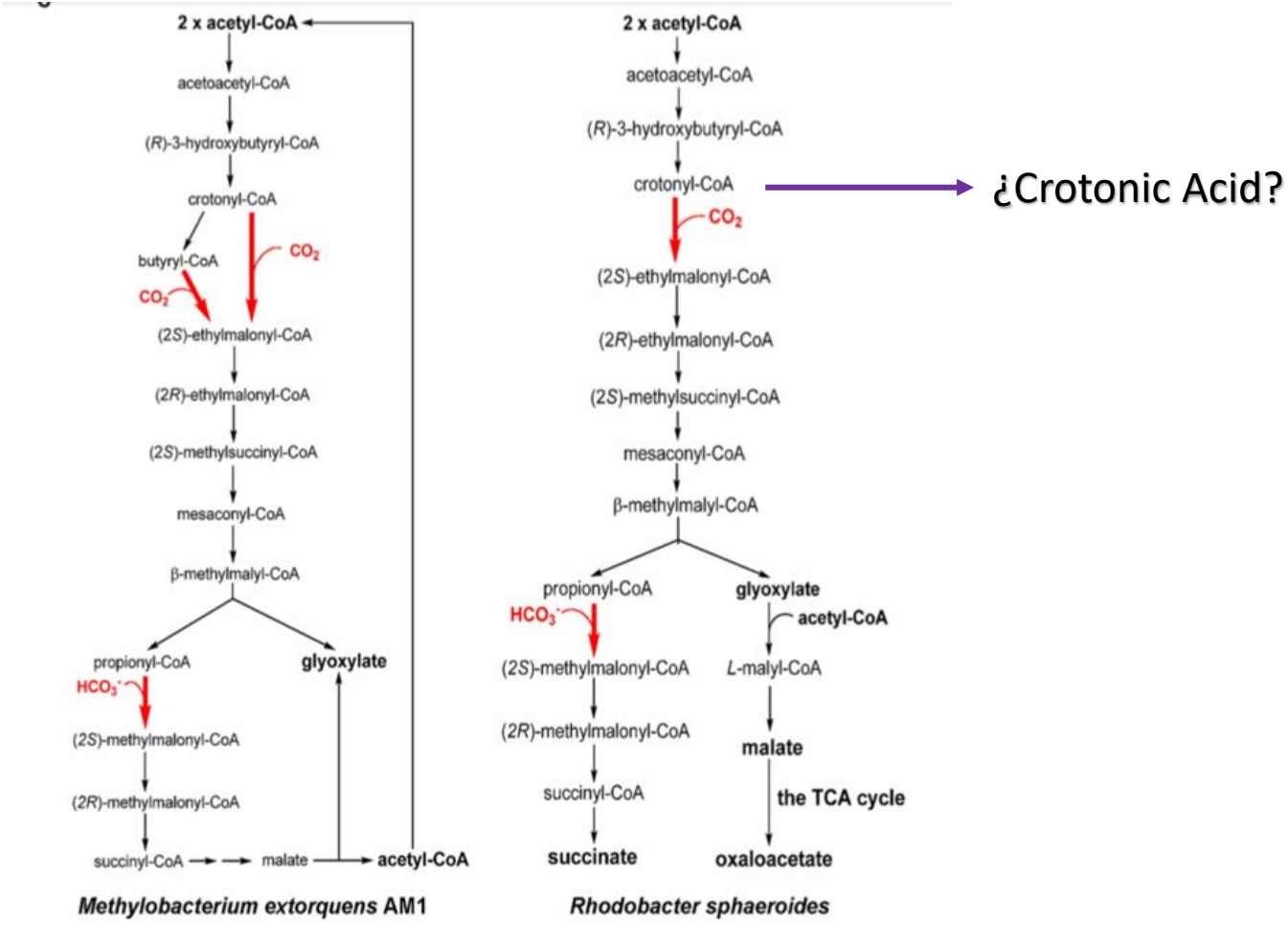
Experiment: 1 g L⁻¹ Acetate + 0.5 g L⁻¹ Butyrate



- Only 10% PHA
- Surprise appearance: Crotonic Acid

Results

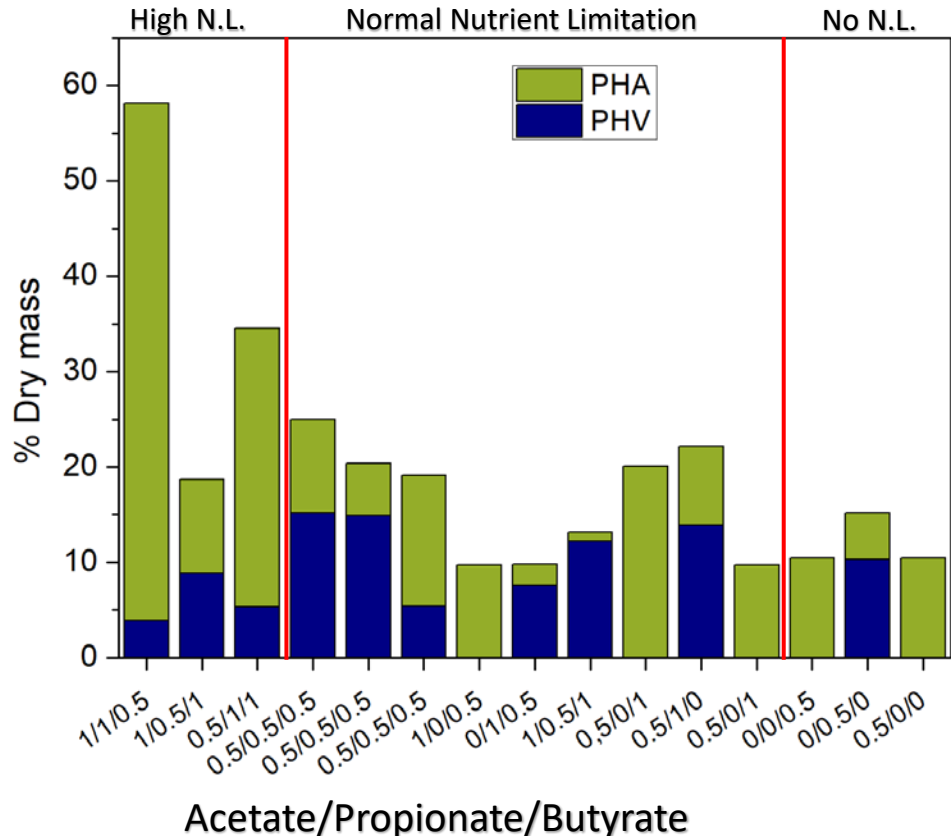
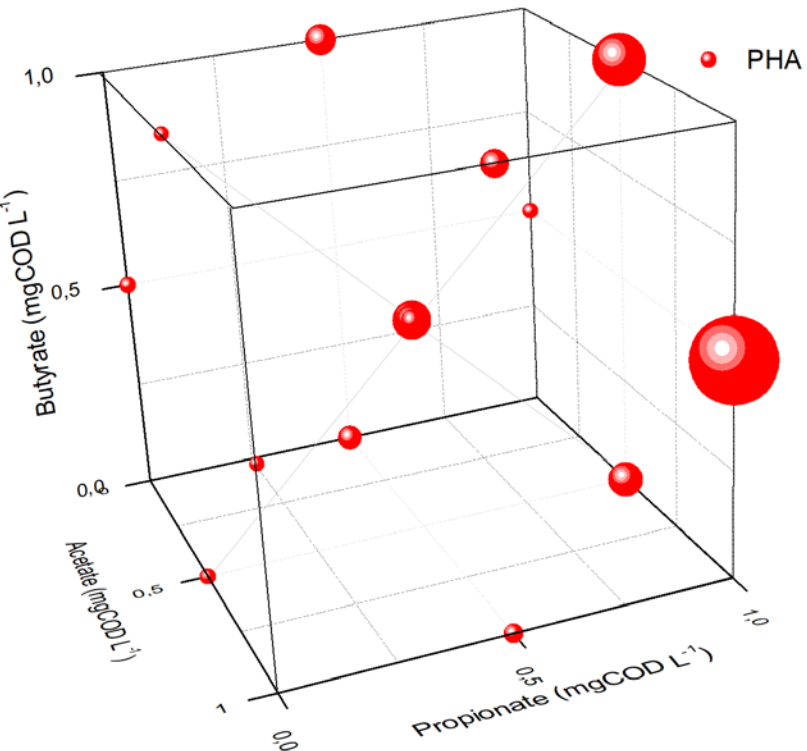
Acetate assimilation pathways



Carbon Metabolic Pathways in Phototrophic Bacteria and Their Broader Evolutionary Implications, *Front. Microbiol.* (2011) 165.

Results

Photo-heterotrophic process



- P(3HB-3HV) co-polymer appear only when propionate is present
- Best ratio: 1/1/0.5 -> HAc/HPr/HBu

Conclusions

Key findings

- Up to 58% accumulation of PHA on dry mass
- Best ratio: 1/1/0.5 -> HAc/HPr/HBu
- PHA production is improved with the combination of acetate and propionate
- Propionate is essential to produce P(3HB-3HV) co-polymer

Conclusions

Future perspectives

- Try to optimize the fermentation towards the selective production of acetate and propionate
- Modelling of PHA production from HAc/HPr/Hbu by PPB
- Study the role of Crotonic acid in the redox state of PPBs

Thank you!

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