Sugar Beet Pulp as a substrate for carboxylate production by mixed culture fermentation

Maxime Velings, G. B. L. Henry, P. A. Gerin
maxime.velings@uclouvain.be
Université catholique de Louvain (UCLouvain), Applied Microbiology, Unit of Bioengineering, Louvain-la-Neuve, Belgium

Research Background

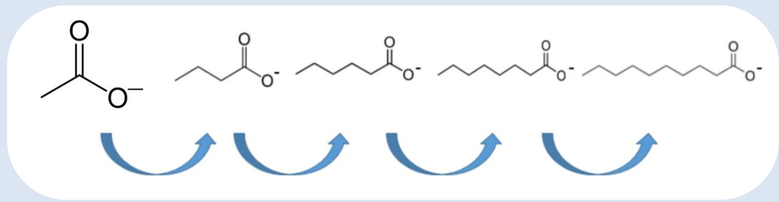
Sugar beet pulp (SBP):

- 20 million tons in Europe each year (1),
- contains carbohydrates, proteins and fibers,
- dried and stored without affecting fermentation possibilities (1).

Medium chain fatty acid (MCFA): CH_3-$(CH_2)_{4-8}$-COOH

- carboxylate plat form chemicals (2) : biopesticides, solvents, biofuels, etc.

Carboxylate production



2 H_2 + H^+ + acetate-

Aim of the research

- Sugar Beet Pulp bioconversion to Medium Chain Fatty Acids by mixed culture acidogenic fermentation
- Influence of pH, substrate and acetic acid concentrations on the MCFA yield

Experimental conditions

1. Wastewater sludge as mixed inoculum
2. Dried SBP as raw substrate
3. Acetic acid (C2) as co-substrate
4. H_2 gas as a source of additional reducing equivalents

Initial concentration

Substrate 40g/L	Gas	Acetate 5 g/L_ML	Inoculum	Oligo-elements	Initial pH	Target pH
-	H_2	+	+	+	6	7
SBP	H_2	+	+	+	6	7
	N_2	+	+	+	6	7

Results

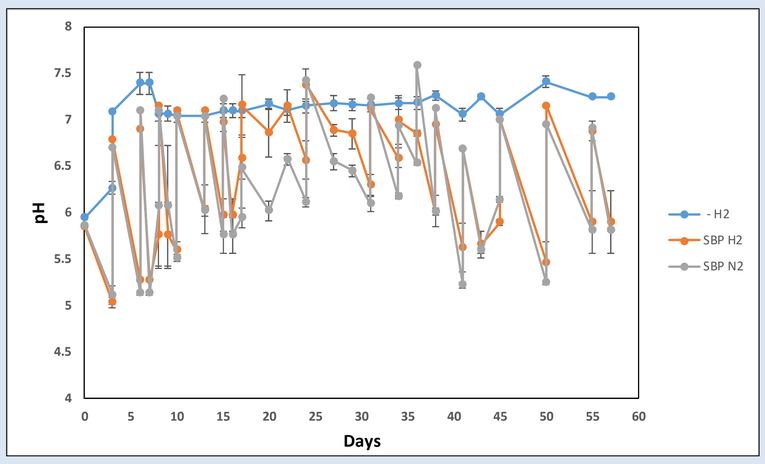
Total pressure between 0.8 & 1.55 10^5 Pa
H_2 pressure between 0.6 & 1.2 10^5 Pa

1. Substrate composition:

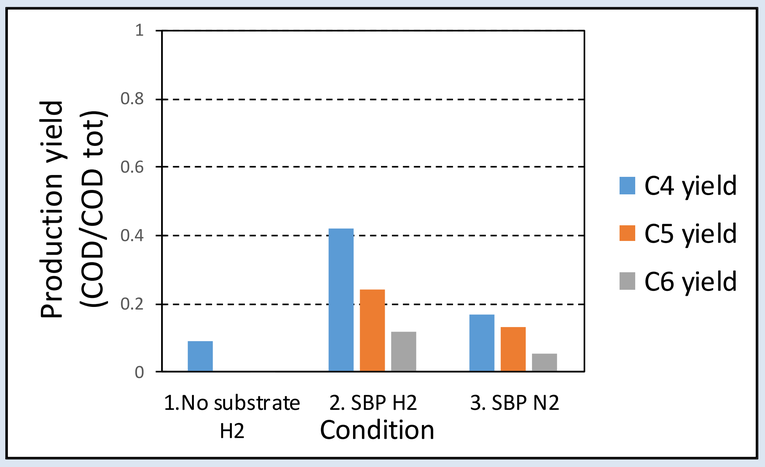
- Dry Matter ($\%_{Fresh\ Matter}$): 91.2±0.0
- Volatile matter ($\%_{Dry\ Matter}$): 94.0±0.001
- Chemical O_2 Demand ($g_{COD}/g_{Fresh\ Matter}$): 1.023±0.007
- Cellulose ($\%_{Dry\ Matter}$): 20.6±0.02
- Hemicellulose ($\%_{Dry\ Matter}$): 32.1±0.9
- Lignin ($\%_{Dry\ Matter}$): 2.7±0.3
- Proteins ($\%_{Dry\ Matter}$): 9.6±0.1
- Free sugars ($\%_{Dry\ Matter}$): 0.1±0.1
- Pectin ($\%_{Dry\ Matter}$): 11.2±0.1

(3)

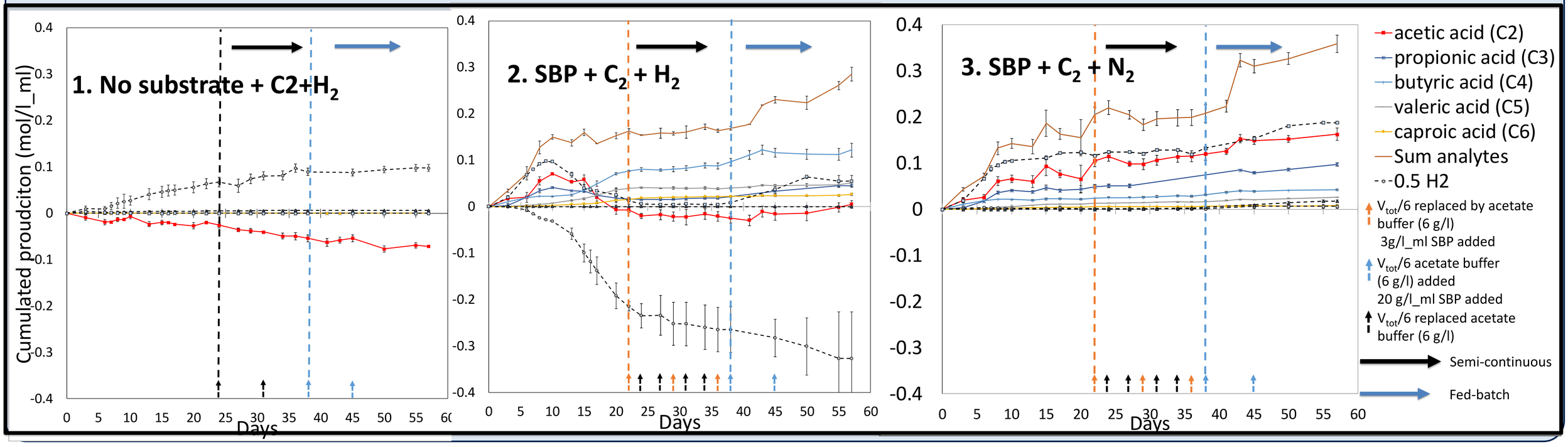
2. Fermentation pH



4. Bioconversion yield



3. Metabolite production - consumption



Conclusion

Carboxylate production is enhanced by:

- ✓ SBP initial concentration and addition during the fermentation
- ✓ An external source of reducing equivalents (H_2 gas)

Perspectives

- → Increased substrate concentration
- → Semi-continuous process
- → pH stabilized at 7

References:
(1) Grumezescu, Holban, 2018; (2) Cherubini, 2010; (3) Perimenis et al., 2015