Fermentation and recovery of bio-refinery thin stillage to volatile fatty acids with zero-chemical input

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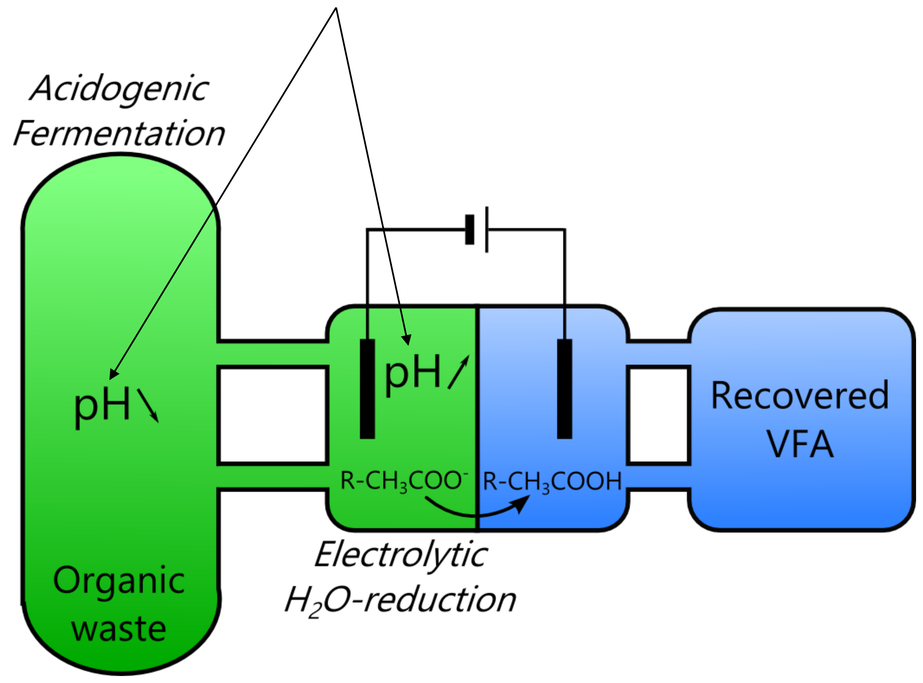
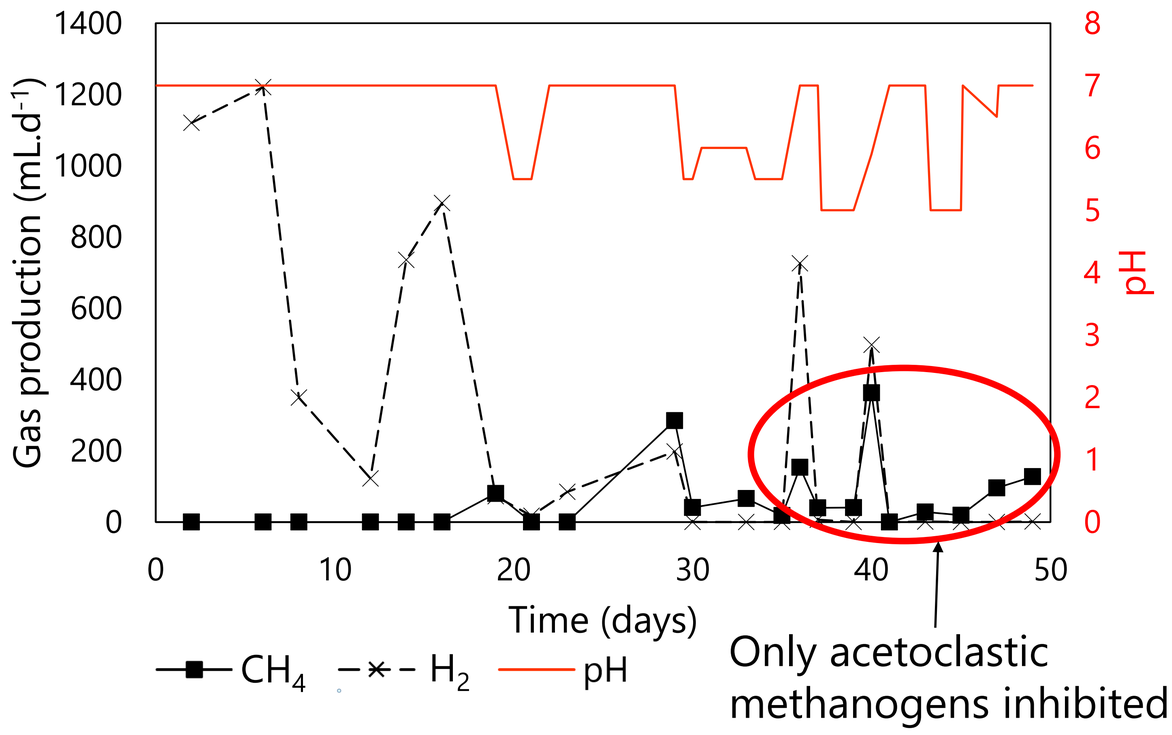
Volatile fatty acids (VFA) – applicable as building blocks in the chemical industry - can be produced through fermentation of biorefinery waste streams. The main drawbacks to be addressed are: i) inhibition of methanogenesis and chemical input for pH control; ii) product extraction from fermentation broth; and iii) steering the microbiome towards target products. All three of these key issues are tackled using membrane electrolysis coupled to an acidogenic fermenter.

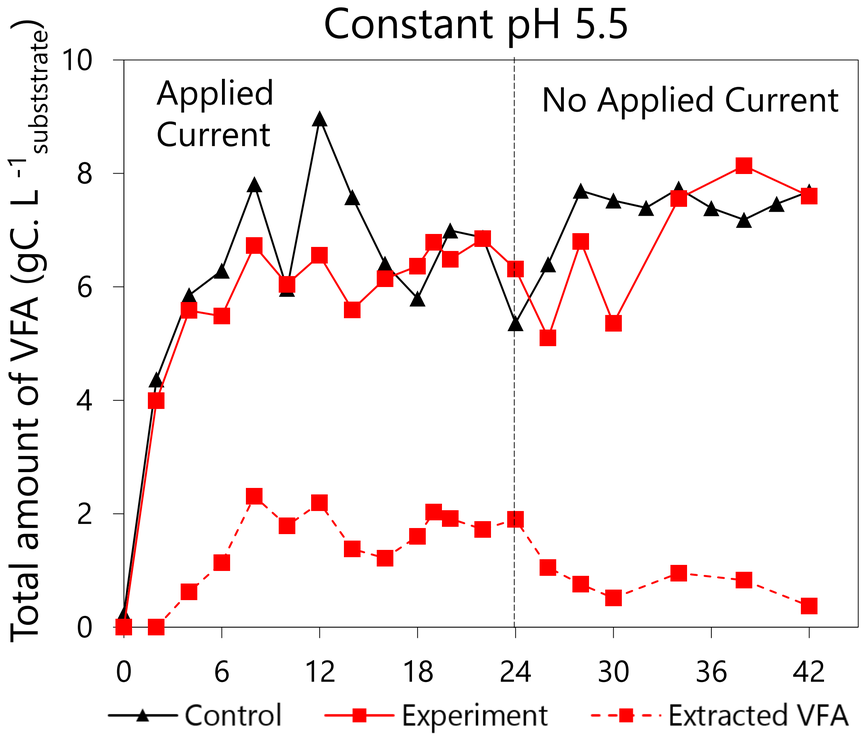
1. Methanogenic activity

Chemical-free pH-oscillation for inhibition of methanogens





2. Separation of product



VFA-production

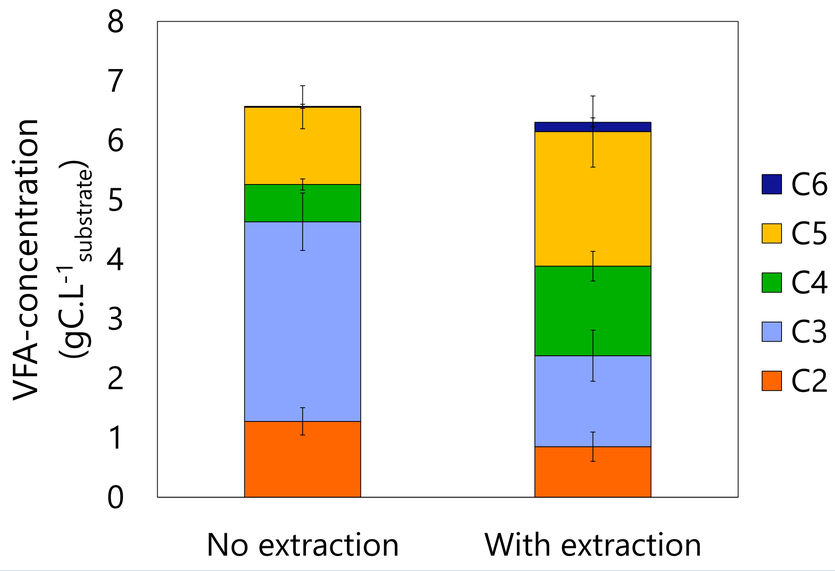
No significant influence of extraction on total production

Recovery of VFA

28.2±3.8% of produced VFA extracted as acids in a clean stream with unoptimised extraction

Elongation of VFA

With extraction coupled, fermentation yields longer VFA



3. Ecology of the fermenting community

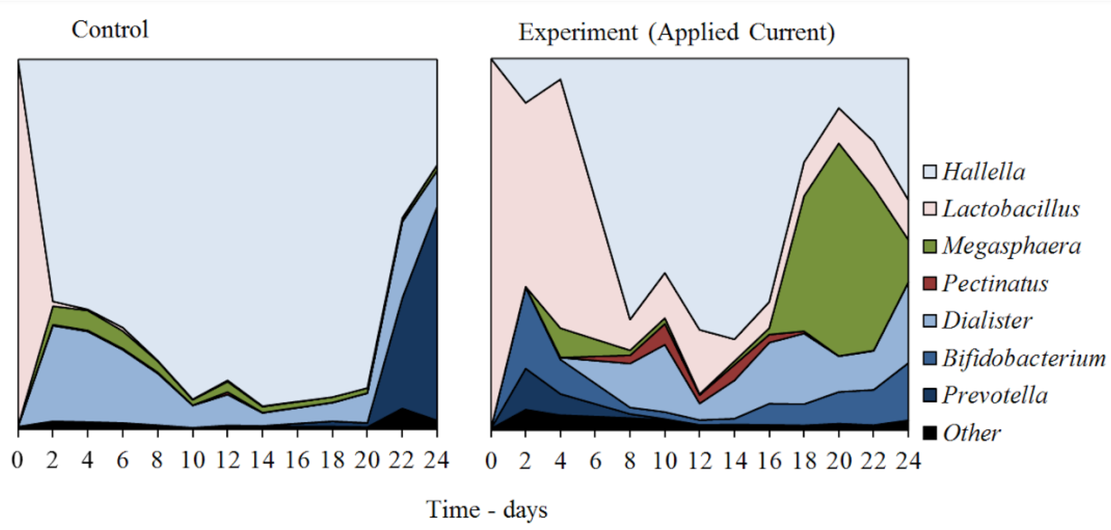
Lactobacillus spp. and *Megasphaera sp.* elongation?

Acetate + Lactate → Butyrate + CO_2 + H_2O
Butyrate + Lactate → Caproate + CO_2 + H_2O
Propionate + Lactate → Valerate + CO_2 + H_2O

H_2-driven selection of elongating species?

$NAD^+ + H_2 \rightarrow NADH + H^+$
→More energy for H_2-consumers

To be confirmed



Acknowledgments

For generously providing the thin stillage used in these experiments