

# The impact of externally added hydrogen gas on microbial electrosynthesis from CO<sub>2</sub>

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## Introduction

Hydrogen is a key versatile biomolecule in MES. It can be directly produced by electrolysis to be used as an intermediate, directly biosynthesized by electroactive microorganisms from protons and electrons, or externally added to drive other bioelectrochemical or biological reactions. The aim of this study is to bring further understanding on how externally added hydrogen impacts product formation on MES.

## Materials and Methods

### Reactor:

Two double-chamber microbial electrolysis cells were built with a reaction volume of 500mL (Figure 1).

### Cathode:

175 cm<sup>2</sup> carbon felt set at -1V vs. Ag/AgCl, and a platinum wire was used as counter electrode.

### Inoculation and acclimatation:

Following the procedure detailed in Bajracharya et al. 2017 [1].

### Feeding:

A gas mixture containing 20% H<sub>2</sub> / 20% N<sub>2</sub> / 60% CO<sub>2</sub>. After 2 weeks of operation hydrogen was removed from the feed ( 20% N<sub>2</sub> / 80% CO<sub>2</sub>), in order to identify hydrogen driven metabolic products.



Figure 1: Reactor set-up

## Results and Discussion

During the first period in which hydrogen was externally added, days 0-14 (Figure 2), ethanol and acetate production followed a similar growing trends. However, after externally hydrogen was removed from the gaseous feed, ethanol concentration started to decline, and disappeared from the catholite after day 31. During this period acetate concentration sharply increased showing CO<sub>2</sub>-acetate selectivity near 100%, days 14-31 (Figure 2). This suggests that hydrogen acts as a reducing agent driving direct production of ethanol, or even its secondary production from acetate and hydrogen itself.

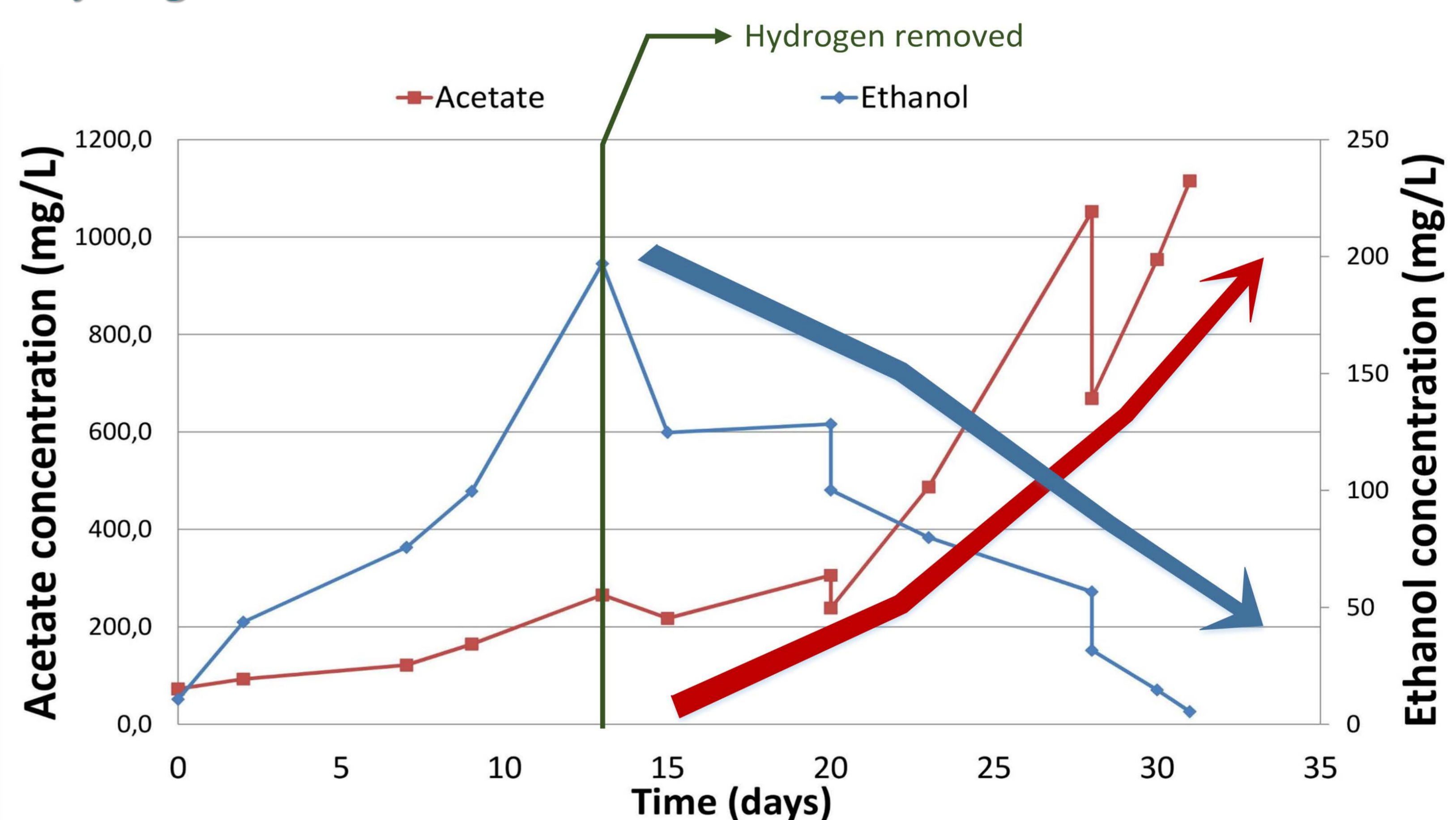


Figure 2: Acetate and ethanol concentration in the catholite along the experiment

## Conclusions

- Externally added hydrogen plays a key role on MES.
- This experiment indicate how ethanol production is highly dependent on externally-added hydrogen.
- Bioelectrosynthesis of acetate, on the other hand, only requires the cathode as reducing agent to provide a source of electrons.

### Reference

[1] Bajracharya, S., Yuliasni, R., Vanbroekhoven, K., Buisman, C.J.N., Strik, D.P.B.T.B., Pant, D., 2017. Bioelectrochemistry, 113, 26–34.

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