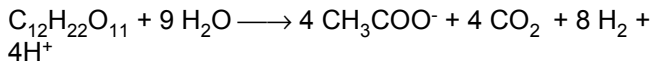


Inhibition factors of hydrogen production by the extreme thermophile *Caldicellulosiruptor saccharolyticus*

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Introduction

Little is known yet about the metabolic properties of (hyper) thermophilic anaerobes. We studied the effect of various compounds present in the culture, on the production of H₂ by *Caldicellulosiruptor saccharolyticus*. Sucrose was used as a model substrate. It is mainly fermented according to:



At a partial H₂ pressure >1.7·10⁴ Pa also lactate starts being produced according to:

The inhibition kinetics was determined in growing cultures with various inhibitors (H₂, H₂SO₄, acetate, lactate, and NaCl). The data were fitted according to Han & Levenspiel (1988) using the least squares method:

$$r_{H_2} = r_{H_2}^{max} \cdot (S/(K_S+S)) \cdot (1 - I/I_{CRIT})^n$$

Results

The inhibition kinetics are shown in Fig. 1 and parameter values in Table 1. High concentrations of sodium acetate caused lysis of 20% of the culture (Fig. 2).

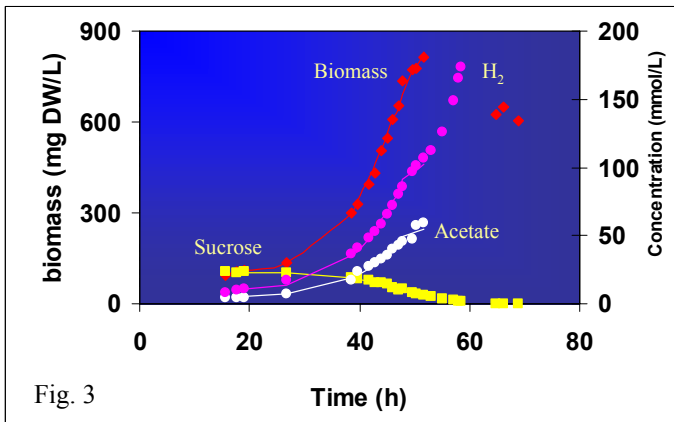


Fig. 3

References

Han & Levenspiel (1988) Biotechnol Bioeng 32:430.

Joliffe et al. (1981) Cell 25:753.

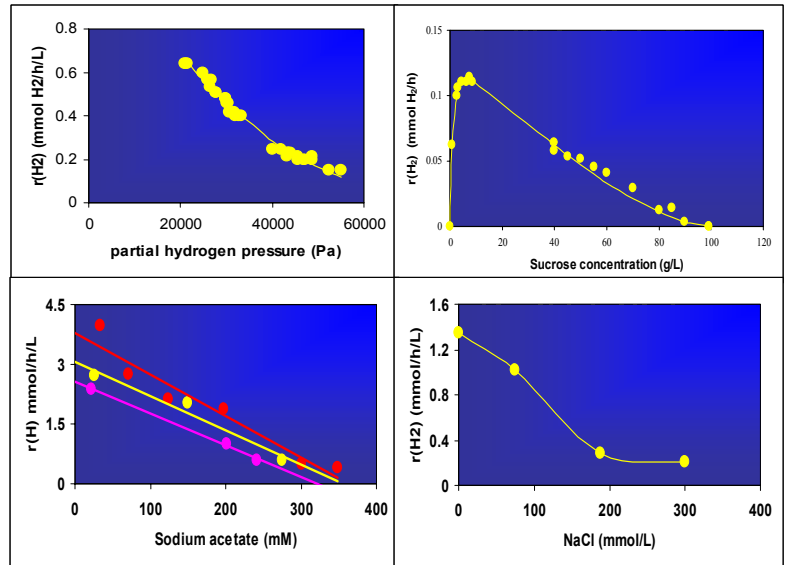


Fig. 1

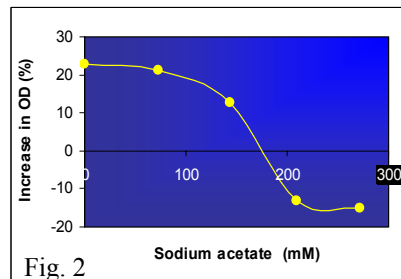


Fig. 2

Table 1. Parameter values.

Inhibitor	I _{CRIT} (mM)	n (-)
H ₂	0.1	3.1
Sucrose	292	1.6
Na-acetate	370	1
Sodium	255	1

According to model fitting, growth in batch culture was inhibited by sodium acetate. Figure 3: data points are fitted with the equation:

$$X = X_0 \cdot \exp\{(\mu_{MAX} \cdot S/(K_S+S)) \cdot (1 - A/A_{CRIT}) \cdot (t-t_0)\}$$

with X = biomass, μ_{MAX} = 0.125 h⁻¹, K_S = 2.3 mM, A = acetate (mM), A_{CRIT} = critical acetate (370 mM), t = time (h)

Yield factors found: Y_{SX} = 45.1 g DW/mol sucrose; Y_{ATP} = 14.1 g/mol ATP (under assumption: 1ATP/acetate)

Conclusions

- *C. saccharolyticus* is about 10 times less sensitive to H₂ than other thermophiles described in the literature
- H₂ production is influenced most by acetate and Na⁺
- Like observed with *Bacillus subtilis* (Joliffe et al, 1981), acetate and/or Na⁺ at high concentrations cause autolysis
- Unlike *B. subtilis*, lysis is restricted to only about 20% of the culture

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