MICROBIAL SYNGAS CONVERSION BY MESOPHILIC AND THERMOPHILIC ANAEROBIC MIXED-CULTURES

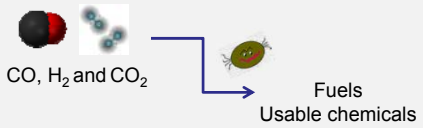
JOANA I. ALVES*
Supervisors: Madalena Alves, Diana Z. Sousa
* joana.alves@deb.uminho.pt

University of Minho
School of Engineering
Centre of Biological Engineering

FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

Introduction

Synthesis gas (or syngas) can be produced from the gasification of a variety of recalcitrant or biodegradable waste materials. Syngas is a mixture composed of mainly H_2, CO and CO_2 that can be used in a biological process for the production of fuels or usable chemicals. The main goal of this work was to study the physiology and microbial composition of anaerobic cultures able to utilize syngas.



Methods

Enrichment cultures

Substrate (series M1, T1 and T2)

	CO	H_2	CO_2
Syngas from coal gasification	60%	30%	10%

Syngas was diluted with H_2/CO_2 (80:20 v/v) to provide CO concentrations ranging from 5% to 50% CO to the cultures.

Substrate (series T2)

CO diluted with N_2 to provide CO concentrations from 10% to 50% CO to the cultures.

Total pressure = 1.75 bar


37 °C — Mesophilic suspended sludge from a labscale bioreactor


55 °C — Thermophilic suspended sludge from a reactor treating organic municipal solid wastes

Monitoring

Gas composition (gas chromatography), soluble fermentation products (liquid chromatography)

Microbial growth (spectrophotometry, abs 600 nm)

Microbial communities (16S rRNA based PCR-DGGE, cloning and sequencing)

Results

Mesophilic enrichment series

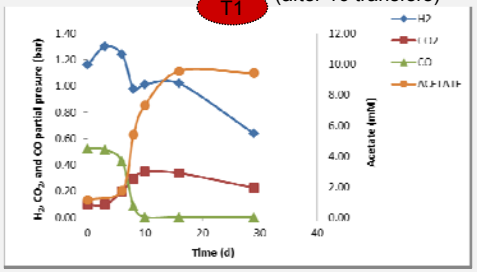
	M1
Substrate:	Syngas (3 transfers)
CO concentration:	5% to 10%

- After 2 transfers there were no growth, neither syngas or CO conversion.
- After 2 transfers the biomass also lost the ability to produce methane, that was being produced during 1st transfer.

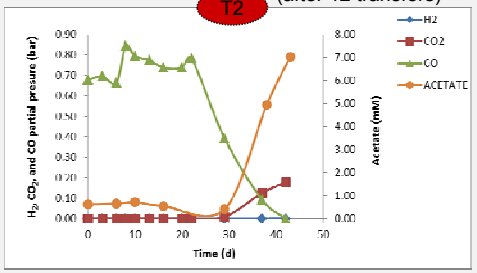
Thermophilic enrichment series

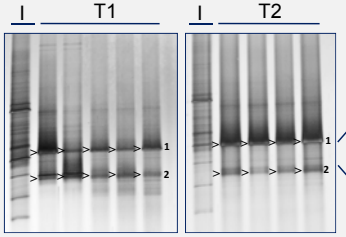
	T1	T2
Substrate:	Syngas (4 transfers) Syngas (12 transfers)	Syngas (4 transfers) CO (8 transfers)
CO concentration:	5% to 50%	5% to 50%

T1 (after 16 transfers)



T2 (after 12 transfers)





Desulfotomaculum sp. Hbr7 (99% identity)

Desulfotomaculum australicum str. AB33 (98%)

Thermophilic anaerobic bacterium K1L1 (96%)

Thermoanaerobacterium aotearoense (86%)

Conclusions

- Regarding CO consumption, the thermophilic suspended sludge offers potential advantages over the mesophilic suspended sludge.
- CO degradation was faster on T1, probably because the substrate used during the initial 4 transfers was the same as during the entire experiment.
- The diversity of the microbial community present, decreased drastically from the inoculum sample, suggesting a fast specialization of microbial community on this type of substrate.

This work gave insight into the microbiology and physiology of syngas and carbon monoxide conversion by anaerobic mixed culture.

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Acknowledgements

The financial support from Fundação para a Ciência e Tecnologia (FCT) and European Social Fund (POPH-QREN) trough PhD grant SFRH/BD/48965/2008 given to Joana Alves is gratefully acknowledged.