Development of a thermophilic and cellulolytic consortium to improve anaerobic digestion of lignocellulosic biomass.

R. Kinet1**, F. Delvigne1, J. Destain1, S. Hiligsmann2, P. Thonart1

1 ULg – Gembloux Agro-Bio Tech, Bio-Industries Unit. Passage des Déportés, 2, Gembloux, B-5030, Belgium.
*corresponding author: r.kinet@doct.ulg.ac.be
2 ULg – Service de Technologie microbienne, Boulevard du Rectorat 29, Liège, B-4000, Belgium

Context and objectives

Hydrolysis of cellulosic substrate = Limiting step

Development of an anaerobic cellulolytic consortium to improve methane production

Method

Isolation of the enriched microbial consortium:

- Enrichment method:
  - Compost as microbial inoculum (10%)
  - Anaerobia, 55°C, static
  - Filter paper 1% (v/v)
  - Transfer after 5 days growth

- Degradation potential (one week, 10 g/l of substrate):
  - Filter paper → 99%
  - Microcrystalline cellulose → 98%

Results

Impact of cellulolytic microbial consortium on biogas production

- Cellulosic substrate
- Lignocellulosic substrate

Characterization of isolated consortium

- Cellulose degradation kinetics
  - Kinetics similar to sigmoidal microbial growth curve

- Microbial community structure
  - pH evolution induces population evolution
  - Cellulose degrading species:
    - Clostridium thermocellum
    - Thermoaerobacterium thermosaccharolyticum

Metabolites of cellulose anaerobic degradation

- Glucose accumulation only during the first 91 hours
- Acetate and ethanol are predominant metabolites and are produced since the start
- Butyrate is measured from 163 hours
- pH decrease due to VFA accumulation

Conclusions

- Enrichment method, with high temperature compost as microbial source, permitted to obtain an efficient cellulolytic anaerobic and thermophilic consortium
- Positive impact of isolated consortium on biogas production.
- Acetate and ethanol are the prevailing metabolites produced during anaerobic cellulose degradation.
- Medium parameters evolution induced important modification of the microbial community structure.

This work is supported by the national found for scientific research, Brussels, Belgium