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DIFFERENTIAL EFFECTS OF CARBON-BASED AND IRON-BASED CONDUCTIVE MATERIALS IN ANAEROBIC BUTYRATE-DEGRADING ENRICHMENTS

Braga, Cátia[1,2]; Salvador, Andreia[1,2]; Duarte, M. Salomé[1,2]; Martins, Gilberto[1,2]; Pereira, Luciana[1,2]; Soares, O. Salomé[3]; Pereira, M. Fernando[3]; Pereira, Inês[4]; Alves, M. Madalena[1,2]

1 - CEB - Centre of Biological Engineering, University of Minho, 4710-057 Braga, Portugal; 2 - LABBELS – Associate Laboratory, Braga, Guimarães, Portugal; 3 - Laboratório de Catálise e Materiais (LCM), Laboratório Associado LSRE-LCM, Faculdade de Engenharia, Universidade do Porto, Portugal; 4 - Instituto de Tecnologia Química e Biológica António Xavier, Universidade Nova de Lisboa, Av. da República, 2780-157 Oeiras, Portugal

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Introduction

Conductive materials (CM) accelerate methane production (MP), probably by promoting more efficient interactions between bacteria and methanogens.

This work investigates the effects of activated carbon (AC) and magnetite (Mag) in microbial enrichments degrading butyrate. Three different butyrate-degrading enrichments were developed: 1) without CM, 2) with AC, or 3) with Mag. It was also investigated if the effect of CM persisted when CM-adapted enrichments were transferred to new medium without CM, and if CM affected the activity of stable enrichments without previous contact with CM.

Methodology

Enrichment series were initiated with granular anaerobic sludge as inoculum, butyrate (10 mmol/L) as substrate, and CM (0.5 g/L AC or 0.5 g/L Mag), or without CM, and incubated at 37 °C, under strict anaerobic conditions.

The following parameters were monitored: methane by gas chromatography; butyrate and acetate by high performance liquid chromatography; oxidation-reduction potential; pH and conductivity. RNA was extracted and taxonomic composition of the microbial communities was obtained by 16S rRNA gene sequencing.

Results

During the first incubations, AC-enrichment consumed hydrogen derived from butyrate degradation within 4 days, which was much faster than the enrichments with Mag and without CM, which presented lag phases (LP), preceding MP, longer than 11 and 7 days, respectively. Thus, Mag probably inhibited butyrate-degrading bacteria and/or hydrogenotrophic methanogens. Conversely, after the lag phase, Mag-enrichment was the fastest converting acetate to methane (3 times faster than in AC-enrichment), suggesting a stimulatory effect of Mag towards acetoclastic methanogens.

Nevertheless, once the enrichments were adapted to the growth conditions, more efficient butyrate conversion was observed by all enrichments, with lag phases lower than 4 days, even in the control-enrichment.

No significant changes on butyrate degradation were observed when highly adapted CM-enrichments were transferred to fresh medium without CM. On the other hand, when active enrichments (without previous contact with CM), were incubated with AC, it became slightly faster (0.7 times shorter LP), and with Mag were greatly inhibited (12 times longer LP).

Syntrophomonas spp. represented 60 to 80 % of the total bacterial communities in all enrichments. Hydrogenotrophs were more abundant in AC-enrichment (78 % of *Methanomicrobiales*) and Mag-enrichment was highly enriched in acetoclastic methanogens (43 % of microorganisms assigned to *Methanosaeta* and *Methanosarcina*).

Conclusions

The presence of CM affects the performance of butyrate-degrading communities, with AC accelerating particularly butyrate conversion to methane (via H_2/CO_2) and acetate, and Mag inhibiting that first step but stimulating acetate conversion to methane.