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Enhancing methane production from fat by bioaugmenting *Syntrophomonas zehnderi* to anaerobic sludge

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Abstract

Long-chain fatty acids (LCFA) are commonly present in fatty-wastewaters and can be used for biogas production in bioreactors. The conversion of these compounds to methane is strongly dependent on the synchronized activity of acetogenic syntrophic bacteria and methanogenic archaea. Bioaugmentation of anaerobic sludge with LCFA-degrading bacteria can be strategically used to enhance methane production from fat. *Syntrophomonas zehnderi* is an obligate syntrophic bacterium that is able to degrade saturated and unsaturated fatty acids with 4 to 18 carbons[1]. This feature makes it potentially suitable as a bioaugmenting strain to enhance degradation of the wide range of LCFA present in wastewater.

In this work, the potential of bioaugmenting anaerobic sludge with *S. zehnderi* as a means of improving methane production from oleate was evaluated. *S. zehnderi* was pre-grown in a bicarbonate-buffered anaerobic medium supplemented with oleate, at 37 ºC. Two sets of bottles were then prepared, with and without sepiolite, a solid microcarrier. The microcarrier was used to investigate a potential increase in the microbial kinetics properties during LCFA degradation[2]. In each set of bottles, a non acclimated granular sludge was bioaugmented with the co-culture and fed with 1 mM sodium oleate. Blank assays (without oleate) and control assays (with inactivated co-culture) were also prepared. Inactivation of the co-culture was performed by heat treatment (121 ºC, 40 min, 2x). Methane, LCFA and volatile fatty acids were monitored during the assay by GC and HPLC.

Oleate could be degraded by bioaugmented and non-bioaugmented sludges, as verified by GC analysis at the end of the experiment. However, methane production in bioaugmented assays was faster, either with or without microcarrier. For the assays with sepiolite, about 71% of the initial substrate could be accounted for the methane measured after 12 days of incubation in bioaugmented sludge; a much lower methane yield, i.e. 13%, was observed in non-bioaugmented bottles. A high methane recovery, i.e. 92%, was also achieved in bioaugmented assays without microcarrier, though only after 32 days of incubation. The potential of bioaugmenting anaerobic sludge with *S. zehnderi* for efficient LCFA conversion to methane was shown, as the presented results evidence an improvement in the kinetics of the process and methane recovery from oleate.

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