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Bioaugmentation strategies to enhance long chain fatty acids (LCFA) conversion to methane

Sérgio Silva, Ana Júlia Cavaleiro, Madalena Alves, Diana Sousa
Institute for Biotechnology and Bioengineering - Centre of Biological Engineering, Portugal

Bioaugmentation of bioreactors with LCFA-degrading bacteria is a possibility for improving methane production from lipid-rich wastes/wastewaters. Cavaleiro et al. [1] has shown that methane production from oleate (unsaturated LCFA) is faster and more efficient in batch tests bioaugmented with *Syntrophomonas zehnderi*, a bacterium that is able to degrade a wide range of both saturated and unsaturated LCFA [2].In this work, anaerobic sludge bioaugmentation with *S. zehnderi* was studied in order to evaluate: (I) the recovery of bioreactors after an episode of LCFA overload; (II) the potential for decreasing reactor start-up periods. The potential of using *S. zehnderi* for recovering LCFA-overloaded sludge was tested using anaerobic sludge collected from a oleate-fed bioreactor at three different operation times. Bioaugmentation batches were prepared with LCFA loaded biomasses in the presence of *S. zehnderi*. Controls were set using inactivated *S. zehnderi*. Methane yields of 72, 53 and 40% were obtained from the first, second and third collected sludge samples respectively. However, addition of *S. zehnderi* did not significantly improve LCFA conversion loaded-sludges as similar yields were achieved in non-bioaugmented controls.Fed-batch bioreactor start-up, using a non-acclimated sludge, was attempted in the presence of *S. zehnderi*. Assays were conducted in the presence and absence of both a solid microcarier (sepiolite) and a substoichiometric amount of ferric hydroxide. Blank (no oleate) and control assays (inactivated *S. zehnderi*) were also prepared. Bioaugmentation assays with sepiolite and ferric hydroxide showed the highest methane yield, with an observed methane yield 16% higher than in non-bioaugmented controls.The potential of bioaugmenting *S. zehnderi* as means to recover methanogenic activity of LCFA-loaded biomass was not demonstrated. However faster reactor start-up could be accomplished since higher methane yield was achieved in bioaugmented fed-batch assays in the presence of sepiolite with ferric hydroxide.

[1] Cavaleiro et al 2010. Water Res 44:4940-7. [2] Sousa et al 2007. Int J Syst Evol Microbiol 57:609-15. *This study has been funded by FEDER, through the COMPETE program, and by Portuguese funds, through Portuguese Foundation for Science and Technology (FCT), in the frame of the project FCOMP-01-0124-FEDER-014784.*