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# MIXED CULTURE BIOTECHNOLOGY FOR BIOFUELS PRODUCTION IN SYNGAS FERMENTATION PROCESSES

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## Abstract

Syngas fermentation is one of the most promising approaches among second generation biofuel technologies due to the benefits derived from the combination of thermochemical and biochemical conversion processes. In this process, a wide array of feedstocks of different nature can be converted through gasification into synthesis gas, composed by mainly $H_2$, CO and $CO_2$, which can be further converted biologically into both gaseous and liquid biofuels. The fermentation of synthesis gas has been typically carried out by pure cultures. However, using open mixed cultures and taking thus advantage of their inherent microbial diversity may offer a series of benefits such as high adaptive capacity, resilience to syngas impurities and non-sterile operation [1][2]. All the above may contribute to reducing utility consumption. On the other hand, a poor understanding of the microbial interactions within microbial consortia usually leads to low product selectivity in fermentation processes. Thus, gaining a better control on the activity of microbial consortia is fundamental for the further development of mixed microbial consortia fermentations.

In this work, a number of enrichment strategies were designed for enhancing the microbial activity of anaerobic sludge towards the production of methane and ethanol. The methanogenic potential of the anaerobic sludge was assessed through enrichments at different temperatures, developing a mesophilic (37˚C) and a thermophilic (60˚C) methanogenic consortium. The ethanologenic potential of the anaerobic sludge was evaluated based on enrichments at different initial pH conditions (6, 5.5 and 5).

The results showed that the enrichments led to less complex microbial consortia with a higher microbial activity towards the targeted products. The study of the behaviour of the methanogenic enriched consortia revealed different patterns of activity and inhibition between the mesophilic and the thermophilic consortia, obtaining a methane yield at the end of the enrichments of 81.4% and 92.6% of the theoretical maximum, respectively. In turn, the ethanologenic potential of the enriched consortia was observed to increase as the initial pH was lowered, achieving a maximum ethanol yield of 17.7%, 33.3% and 59.8% of the theoretical maximum in enrichments at pH 6, 5.5 and 5, respectively.

Overall, controlling the operational conditions of the enrichments enhanced both the product yields and the activity of certain catabolic routes towards methane and ethanol. This allowed increasing significantly the overall conversion rate in methanogenic enrichments as well as the product selectivity in ethanologenic enrichments.

**References**

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