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BATCH TESTS OF BIOLOGICAL HYDROGEN PRODUCTION FROM FOOD INDUSTRY WASTES BY FOUR THERMOTOGA THERMOPHILIC STRAINS IN 0.12-L MICROCOSMS AND IN A 19-L FERMENTOR

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Abstract

This work is aimed at evaluating the feasibility of a cost-effective process of biological H_2 production from food industry wastes under thermophilic conditions. The H_2-producing performances of 4 *Thermotoga* strains (*T. neapolitana, T. petrophila, T. naphtophila, T. maritima*) were compared at 77 °C by means of tests conducted in 120-mL batch bioreactors containing a nutrient-rich growth medium additioned with glucose, molasses or cheese whey as carbon source. For all the substrates tested, *T. neapolitana* resulted the best-performing strain under suspended-cell conditions, with a 0.9-1.9 mmol L_{medium}^{-1} h^{-1} H_2 production rate at an 8-10 g L^{-1} initial substrate concentration, and a 1.6-2.6 $mmol_{H2}$ $mmol_{monosaccharide\ consumed}^{-1}$ yield. To compare the 4 strains also under attached-growth conditions, preliminary tests were conducted with glucose-growing *T. neapolitana*, with the goal to select the best biomass carrier among 4 porous materials utilized in biofiltration applications. The best results were obtained with the carrier characterized by the highest interfacial area, equal to 2.1 m^2 g^{-1}. Also under attached-growth conditions, *T. neapolitana* resulted the best strain for all the 3 substrates tested, with a 1.2-1.8 mmol L_{medium}^{-1} h^{-1} H_2 specific production rate. Further tests, aimed at simplifying the growth medium composition, led to encouraging results. For example, in the case of molasses a *minimum medium* composed only by NH_4Cl, K_2HPO_4, NaCl, buffer and cysteine resulted – in comparison with the ATCC 1977 complete medium – in a 73% reduction of medium cost and in a 12% increase of the H_2/substrate yield. Finally, the process scale-up to a 19-L reactor is in progress. The preliminary results indicate that, in the scale-up of batch H_2 production from glucose by *T. neapolitana*, the values of the three monitored yields (H_2/substrate, organic acids/substrate, biomass/substrate) did not show significant variations, whereas the H_2 volumetric production and the initial H_2 production rate resulted to be significantly affected by the concentration of the initial inoculum.

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