SELECTION OF A CONSORTIUM FOR THE PHOTO-FERMENTATIVE HYDROGEN PRODUCTION

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Introduction. Biohydrogen is an attractive energy carrier due to its potentially higher efficiency of conversion to usable power, the non-existent generation of pollutants and a high energy density (122 kJ/g), which is 2.72 times that for gasoline (1). The hydrogen production, using the photo-fermentation culture, is very promising because of the purity of the generated biogas (H_2:80%) (2). However, it must be taking into account the suitable selection of the source of inoculum to obtain the photo-fermentative consortium with the higher hydrogen production.

The objective of this work was to evaluate three sources of inoculum to select the best hydrogen producer consortium.

Methods. Three types of inoculum were tested: 1) from the anode of a bio-electrochemical system used to produce hydrogen (BES), 2) granular anaerobic sludge from a brewery wastewater treatment plant (UASB) and 3) from a natural pond in Veracruz, Mexico (NP). The growth and hydrogen production for each photo-fermentative culture was evaluated using a basal media (3) plus a mixture of sodium acetate/butyrate (AB) (2.46 g/L acetate and 3.30 g/L butyrate) as source of carbon and, glutamate (0.37g/L) as source of nitrogen was used. The pH was 6.8. For the tests, bacteria (50 mg/L) plus 100 mL of medium and the organic acids and glutamate were placed in 160 mL glass bottles, sparged for 20 sec with argon and with illumination of 5000 lux. The tests were conducted by triplicate and 32°C. Molecular techniques (PCR-DGGE) were used in order to evaluate the microbial population dynamics.

Results. In the first selection after three days a red and purple biomass was evidenced in the culture media. Seven days after, it was considered that there was enough biomass and then, from each bottle, a sample of 50 mg VSS L^{-1} was taken to conduct another growth cycle lasting 22 days. The biogas composition was monitored. The Fig. 1 presents the course of specific hydrogen production for three types of inoculum and adjusted using the Gompertz model. From Table 2 it was observed that, in terms of total hydrogen production (H_2, mmol), hydrogen production rate (mmol/d), and the lag phase (h) the best inoculum was BES, followed of NP and UASB.

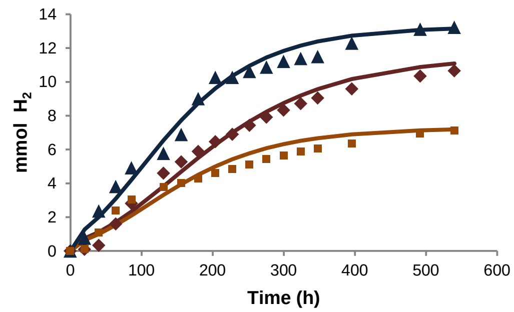

Fig.1 Hydrogen evolution for selected experiments and model adjustment (▲BES, ◆NP, ■ UASB)

Table 1. Production and rate obtained for three inocula.

Inocula	H_{max} (mmol)	R_{max} (mmol/d)	Lag phase (h)	H_2 (%)
NP	11.5	0.84	21	79
UASB	7.3	0.65	9	80
BES	13.3	1.26	6	77

DGGE analysis demonstrates changes in microbial community composition due to the selection experiments. Shannon diversity index (H) varied between 1.7 and 1.6 in the inocula and for the case of BES the final H was 1.1 indicating a low diversity due to the selection of hydrogen producers. The identification of the clones is under study.

Conclusions. The best consortium for photo-fermentative hydrogen production came from a bio-electrochemical system (BES) used to produce hydrogen. A maximal hydrogen production rate of 1.26 mmol H_2/d was found.

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