ELECTRICITY PRODUCTION IN MICROBIAL FUEL CELLS FROM VOLATILE FATTY ACIDS (VFA) AND THEIR MIXTURES

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Key words: MFC; VFA; power generation

Introduction. Nowadays most electricity is obtained from nonrenewable resources; an alternative for the increasing electricity demand consists in the use of biomass in microbial fuel cells (MFC). These devices convert chemical energy from biomass into electrical energy by the catalytic activity of the biofilm developed on an electrode [1]. Interestingly, the intermediate products of dark fermentations can be used as alternative substrates for MFC. In this work, VFAs and different mixtures were evaluated for electricity production in MFCs.

Methods. Two chamber electrochemical cells were constructed in acrylic with 200 mL working volume in each chamber. Carbon felt electrodes were used (4 cm^2) as anode and cathode. Domestic wastewater was the inoculum source. The substrate was added sequentially in the following order: Acetic, Acetic-Butyric (9:1) and Acetic-Propionic-Butyric (1:1/2:2). The MFC performance was estimated by the cell potential (E) and the current density (J); the power cell (P) was calculated by varying the external resistances. The coulombic efficiency (CE) was calculated on the basis of experimental and theoretical coulombs. The substrate consumption was determined by COD. The inoculum was quantified as volatile solids and the biofilm formed was observed with SEM. The microbial community was investigated by amplification and sequencing of 16S rDNA isolated from biofilm samples.

Results. The one-substrate effectiveness was in the order Acetic>Propionic>Butiric; for the mixtures, it was Acetic>Acetic-Propionic-Butyric>Acetic-Propionic. The substrates were added to allow two successive cycles to occur. The second cycle consistently produced higher P than the first cycle. This was due to maturation and acclimation of biofilm to the specific substrates. In Table 1 the performance of MFCs fed with the VFAs is shown. Power production occurred almost immediately after the substrate addition, and

Table 1. Performance of MFC fed with VFAs.

VFA	Cycle	Emax (mV)	Pmax (mW/m^2)	%COD removal	% CE
Acetic	1st	1.5	0.8	66	-
	2nd	59.5	13.5	60	9
Ac-Pro	1st	3.7	0.14	100	0.5
	2nd	1.8	0.1	80	0.5
Ac-Pro-Bu	1st	28.7	7	83	1
	2nd	42.1	10	80	1

the power cycle duration was shortened with the second addition. The Acetic-Butyric mixture produced longer cycles with duration of 11 days, while shorter cycles were observed in the MFC fed with Acetic-Propionic-Butyric (Figure 1). These differences in length and power production were attributed to a more diverse microbial community developed when the more complex VFA mixture was supplied.

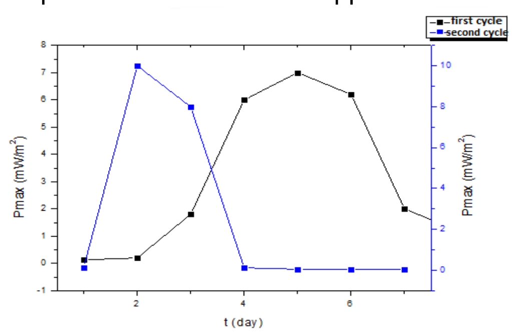

Fig.1 Two cycles of Power density production in the MFC fed with a mixture Acetic-Propionic-Butyric acids.

Conclusions. This work shows the feasibility of treating dark fermentation effluents and producing electricity in the same bioprocess. Additionally, the high impact of the VFA mixture composition on the power generation was revealed.

Acknowledgements. This work was supported by the projects SEP-Conacyt 177441 and 132483. We thank the assistance of D. Partida, JP Rodas, G. Vidriales and G. Labrada from IPICYT.

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