Direct microbial electrosynthesis or hydrogen mediated microbial synthesis of acetate?

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Microbial electrosynthesis (MES) is considered as a promising technology for the production of value added products by bacteria. Most of the studies reporting acetate production by MES have used experimental conditions that favor the production of H_2 by water electrolysis: applied potentials ($E_{app.}$) more negative than -650 mV vs. SCE. Thus, efforts are required to determine whether MES proceeds via i) direct electron transfer (DET) through for example cytochromes in contact with the electrode ("true" MES at $E_{app.} \geq$ -650 mV) or ii) a microbial synthesis process based on H_2-mediated electron transfer (MET) via water electrolysis ($E_{app.} \leq$ -650 mV).

Pure cultures of representative homoacetogens (HA) were grown at -900 mV during chronoamperometry (CA): *Acetobacterium woodii*, *Sporomusa sphaeroides* and *Sporomusa silvacetica*). Multiple tests were carried out at different $E_{app.}$ values (Fig.1A). $NaHCO_3$ and the electrode were the only available sources of carbon and electrons, respectively. Scanning electron microscopy (SEM) was used to inspect the electrode surface (Fig. 1B). Between each $E_{app.}$ cyclic voltammetry (CV) was used to elucidate the possible ET carried out by each strain (Fig. 1C).

Product rate per electrode surface area (P_{ESA}) depended on E_{app}. At -200 mV during CA no acetate was produced. When comparing P_{ESA} at E_{app}. values that favored the production of acetate via MET and values that favored DET, the effect of using H_2 as an electron carrier was clearly shown (P_{ESA}~30 versus 15 g m^{-2} d^{-1} for *S. sphaeroides*). SEM allowed us to observe cells with different shapes attached to the electrode (Fig. 1B). The CV analysis showed the appearance of a reduction peak centered at around -500 mV which might indicate the potential at which electron transfer occurred. By better understanding of the microbial electron transfer mechanisms, new strategies to improve the production of molecules by MES can now be formulated.

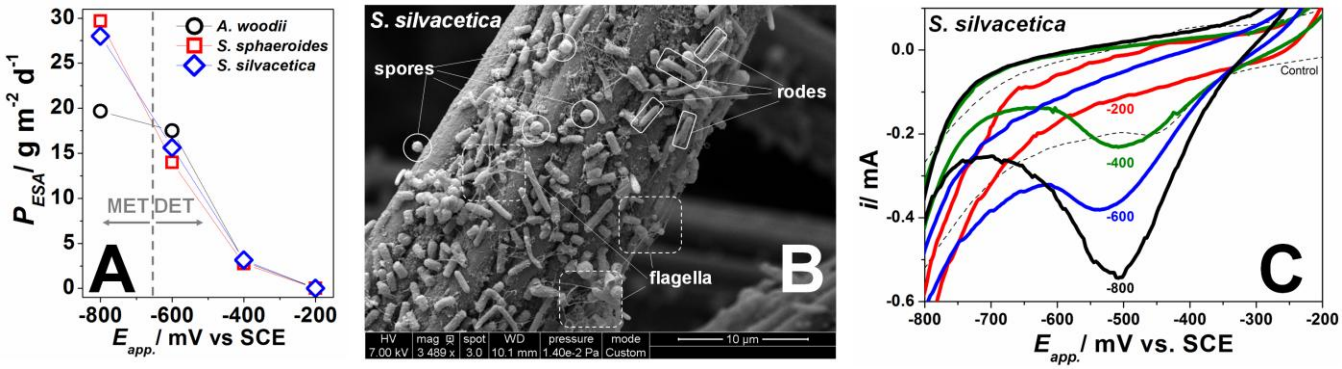

Fig. 1. A) P_{ESA} vs. E_{app}. during CA calculated according to Patil et al., 2015 (*Biotech. Adv.*). B) SEM picture of an electrode fiber cover by *S. silvacetica* cells. C) CVs at different E_{app}. during CA.

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