

Electroactivity of *Clostridium saccharoperbutylacetonicum* 1-4N during Carbon Dioxide Reduction in a Bioelectrosynthesis System

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Abstract : *Clostridium saccharoperbutylacetonicum* 1-4N (Csb 1-4N) is an industrial reference strain for Acetone-Butanol-Ethanol (ABE) fermentation. Csb 1-4N is a solventogenic clostridium and H₂ producer with a metabolic profile that makes it a good candidate for Bioelectrosynthesis System (BES). The aim of this study was to evaluate the electroactivity of Csb 1-4N by cyclic voltammetry technique (CV). The Bioelectrosynthesis fermentation (BES) started in a Triptone-Yeast extract (TY) medium with trace elements and vitamins, Complex Nitrogen Source (CNS), and bicarbonate (NaHCO₃, 4g/L) as a carbon source, run at -600mVAg/AgCl and adding 200uM NADH. The six BES batches were performed with different media composition with and without NADH, CNS, HCO₃⁻, and applied potential. The CV was performed as three-electrode system: platinum slice working electrode (WE), nickel contra electrode (CE) and reference electrode Ag/AgCl (ER). CVs were run in a potential range of -0.7V to 0.7V vs. VAg/AgCl at a scan rate 10mV/s. A CV recorded using different NaHCO₃ concentrations (0.25; 0.5; 1.0; 4g/L) were obtained. BES fermentation samples were centrifuged (3000 rpm, 5min, 4C), and supernatant (7mL) was used. CVs were obtained for Csb1-4N BES culture cell-free supernatant at 0h, 24h, and 48h. The electrochemical analysis was carried out with a PalmSens 4.0 potentiostat/galvanostat controlled with the PStrace 5.7 software, and CVs curves were characterized by reduction and oxidation currents and reduction and oxidation peaks. The CVs obtained for NaHCO₃ solutions showed that the reduction current and oxidation current decreased as the NaHCO₃ concentration was decreased. All reduction and oxidation currents decreased until exponential growth stop (24h), independence of initial cathodic current, except in medium with trace elements, vitamins, and NaHCO₃, in which reduction current was around half at 24h and followed decreasing at 48. In this medium, Csb1-4N did not grow, but pH was increased, indicating that NaHCO₃ was reduced as the reduction current decreased. In general, at 48h reduction currents did not present important changes between different mediums in BES cultures. In terms of intensities in the peaks (Ip) did not present important variations; except with I_{pa} and I_{pc} in BES culture with NaHCO₃ and NADH added are higher than peaks in other cultures. Based on results, cathodic and anodic currents changes were induced by NaHCO₃ reduction reactions during Csb1-4N metabolic activity in different BES experiments.

Keywords : clostridium saccharoperbutylacetonicum 1-4N, bioelectrosynthesis, carbon dioxide fixation, cyclic voltammetry

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