Enhancing electricity production in microbial fuel cells using defined co-cultures

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Microbial fuel cells (MFCs) hold great promise for the simultaneous treatment of wastewater and electricity production. However, the electricity recovery is currently poor, typically <10% of what is theoretically possible, and the extracellular electron transfer mechanisms are poorly understood.

The influence of using cocultures as a way of improving substrate turnover rate and hence electricity produced was investigated using synthetic wastewater as a substrate. Cocultures used were (i) *Shewanella oneidensis* and *Clostridium beijerinckii*; (ii) combinations of *Geobacter sulphurreducens, Clostridium beijerinckii* and *Saccharomyces cerevisiae.* The relative abundances test showed mutualistic relationship within the cocultures and was determined using RT-PCR at the end of the investigation. The coculture *of S.oneidensis* and *C.beijerinkii* gave a maximum power density of 87mWm^{-2} compared to 60 mWm^{-2} for *C.beijerinckii* alone and 48 mWm^{-2} for *S.oneidensis* alone. In the second study the best coculture combination was a mixture of *Geobacter sulphurreducens, Clostridium beijerinckii* and *Saccharomyces cerevisiae* giving a maximum power density of 80 mWm^{-2}.

Another study investigated the contribution of direct electron transfer mechanism on electricity production by physically separating *Shewanella oneidensis* to/from the anode electrode using a dialysis membrane. The outcome of this study indicated a maximum power output of 114±6 mWm^{-2} when cells were restricted close to the anode, 3.5 times more than when the cells were restricted away from the anode. Without the membrane the maximum power output was 129±6 mWm^{-2}.

These results highlight the importance of cocultures and direct electron transfer mechanism in improving electricity recovery in microbial fuel cells. Further work will seek to heterologously express the proteins in Shewanella involved in direct electron transfer in *E.coli*.