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Enhancing electricity production in microbial fuel cells using defined cocultures

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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.beijerinckii* 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*.