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Increase of riboflavin biosynthesis underlies enhancement of extracellular electron transfer of *Shewanella* in alkaline microbial fuel cells

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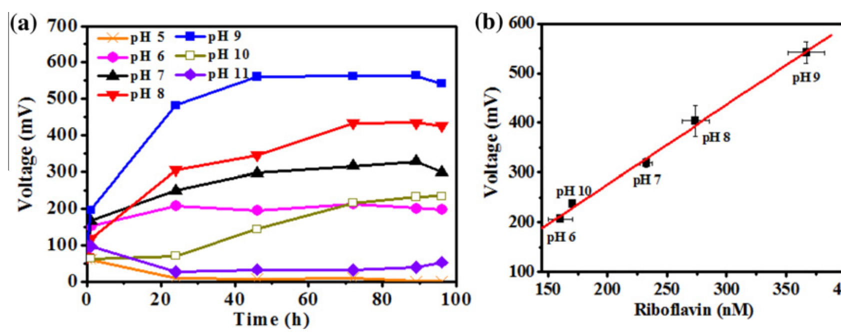
HIGHLIGHTS

- *Shewanella* delivers the highest power output at pH = 9.
- *Shewanella* synthesizes 0.6 times higher level of riboflavin at pH = 9 than 7.
- Increased riboflavin synthesis underlies enhanced electron transfer in *Shewanella.*

GRAPHICAL ABSTRACT



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ABSTRACT

Electrolyte pH tremendously affects the electricity output of microbial fuel cells. However, its underlying molecular mechanism remains elusive, in particular for *Shewanella oneidensis* MR-1, one of the most widely adopted electrogenic microorganisms. Herein, we found that MFCs were able to deliver a significant (but different) electricity output in a wide range of pH (from 6 to 10), with the maximum at pH = 9 (alkaline), which delivers ~1.5 times' higher power output than that at pH = 7 (neutral). Furthermore, cyclic voltammetry analysis showed an enhanced electrochemical activity of riboflavin (responsible for extracellular electron transfer of *Shewanella*) at alkaline pH. Strikingly, the concentration of riboflavin synthesized by *Shewanella* in MFCs at different pH showed a good correlation with the electricity output of MFCs. Thus, our results substantiated that the increase of riboflavin biosynthesis by *Shewanella* at the alkaline condition underlies the improvement of the electricity output in MFCs.

1. Introduction

The microbial fuel cell (MFC) is a renewable energy source that can convert organic wastes into electricity (Alfonta, 2010; Logan, 2009; Lovley, 2006; Rabaey and Verstraete, 2005). Bacteria transfer intracellular electrons generated from the degradation of organic wastes to inert solid electrodes through various extracellular electron transfer (EET) pathways, *i.e.*, direct EET through outer

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