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Enhancing the performance of *Escherichia coli*-inoculated microbial fuel cells by introduction of the phenazine-1-carboxylic acid pathway

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Highlights

- *Escherichia coli* BL21 (DE3) could produce phenazine-1-carboxylic acid efficiently by expressing of *phzA1B1C1D1E1F1G1*.
- Endogenously phenazine-1-carboxylic acid significantly enhanced electrocatalysis in MFC.
- EIS analysis shows decrease in the charge transfer in MFC.
- Introducing the phenazine-1-carboxylic acid pathway into heterologous hosts is an efficient strategy to improve MFC performance

ABSTRACT:

Microbial fuel cells (MFCs) are a renewable green energy source that uses microorganisms to catalytically convert chemical energy into electrical energy. The efficiency of extracellular electron transfer (EET) from the microbe cell to the anode electrode plays a key role in the MFC. However, the insulating properties of the cell membrane limit the efficiency of EET. Herein, EET efficiency was improved by introducing a phenazine synthesis pathway into *Escherichia coli*. Through the heterologous expression of *phzA1B1C1D1E1F1G1*, phenazine-1-carboxylic acid production increased, and the maximum power density increased from 16.7 mW/m^2 to 181.1 mW/m^2. Furthermore, the charge transfer resistance of 6.7 Ω decreased to 4.2 Ω, which reflected the enhancement of the EET efficiency and the electricity power output. Our results imply that introducing a heterologous electron shuttle into *E. coli* could be an efficient approach to improving the EET efficiency and performance of an MFC.

Keywords: Microbial fuel cell; *Escherichia coli*; phenazine-1-carboxylic acid; electron shuttle