

Role of phenazine-enzyme physiology for current generation in a bioelectrochemical system.

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Abstract

Pseudomonas aeruginosa produces phenazine-1-carboxylic acid (PCA) and pyocyanin (PYO), which aid its anaerobic survival by mediating electron transfer to distant oxygen. These natural secondary metabolites are being explored in biotechnology to mediate electron transfer to the anode of bioelectrochemical systems. A major challenge is that only a small fraction of electrons from microbial substrate conversion is recovered. It remained unclear whether phenazines can re-enter the cell and thus, if the electrons accessed by the phenazines arise mainly from cytoplasmic or periplasmic pathways. Here, we prove that the periplasmic glucose dehydrogenase (Gcd) of *P. aeruginosa* and *P. putida* is involved in the reduction of natural phenazines. PYO displayed a 60-fold faster enzymatic reduction than PCA; PCA was, however, more stable for long-term electron shuttling to the anode. Evaluation of a Gcd knockout and overexpression strain showed

that up to 9% of the anodic current can be designated to this enzymatic reaction. We further assessed phenazine uptake with the aid of two molecular biosensors, which experimentally confirm the phenazines' ability to re-enter the cytoplasm. These findings significantly advance the understanding of the (electro) physiology of phenazines for future tailoring of phenazine electron discharge in biotechnological applications.

Involved units

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