

Insights: Publications

Understanding metabolic bioelectrocatalysis of the purple bacterium *Rhodobacter capsulatus* through substrate modulation

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Written by

Photoheterotrophic purple bacterium *Rhodobacter capsulatus* has recently gained attention for its halotolerance and photo-enhanced extracellular electron transfer, which is opening opportunities for self-powered decontamination of saline wastewater. Biodegradation of malate and succinate in *R. capsulatus* electrochemical systems has undergone prior examination, although a consistent bioelectrochemical system to comparatively study multiple carbon sources has not previously been developed. In this study, electrochemical techniques, biological assays, and genetic studies were combined to evaluate malate, succinate, propionate, and lactate as oxidizable fuels in photo-enhanced microbial electrochemical systems. Specifically, cyclic voltammetry and amperometry data demonstrated that *R. capsulatus* generates distinctive current densities dependent on both fuel identity and concentration. Bacterial growth curve studies agreed with electrochemical data, indicating that lactate, which yielded the greatest bio-anodic current density ($9.5 \pm 1.9 \mu\text{A cm}^{-2}$), allowed the bacteria to grow more rapidly than the other substrates, suggesting its effectiveness as a fuel. Finally, differential gene expression analysis allowed for illumination of the physiological underpinnings of the observed differences between substrates. Most remarkably, cells grown in lactate were found to overexpress light harvesting complex II proteins and to underexpress flagellar motility proteins, which both correspond to the higher relative anodic current density in lactate bioanodes.