Utilization of Epigallocatechin gallate (EGCg) as a Shewanella putrefaciens ATP Synthase Inhibitor to Maximize Microbial Fuel Cell Performance

Park, Dahyun

Sanford, Jordan

Traditional wastewater purification is ineffective, costly, and time consuming; additionally, the sludge byproduct is harmful to the environment. According to the US EPA, 3-4% of the nation's electricity powers the municipal wastewater purification systems, creating about 45 million tons of greenhouse gases annually. A microbial fuel cell (MFC) produces zero greenhouse gas emissions and limits the amount of toxic sludge produced, offering a green alternative. Since current laboratory-scaled models are not a realistic replacement for traditional wastewater treatment methods, this study sought to optimize a MFC water purification system and measure its voltage output. A novel MFC was constructed with an anode composed of a platinum-wrapped steel core and a Nafion™ proton exchange membrane to separate the two chambers. Varying amounts of Epigallocatechin gallate (EGCg) were utilized to determine if electrical energy output could be increased by inhibiting the ATP Synthase enzyme of Shewanella putrefaciens, a facultative anaerobe. The control trials (0mg EGCg) produced an average of 511 mV in comparison to the 702 mV average of the 900 mg trials supporting the engineering goal that EGCg utilization will significantly increase the voltage produced by an MFC. Analysis of Regression was used to obtain a p-value < 0.05. Then, using 900mg of EGCg, two long term trials produced an average of 699 mV, demonstrating that the MFC is capable of producing a consistent voltage over longer periods of time. This study's findings indicate that bacterial chemiosmosis modification can result in improved voltage output when compared to other current MFCs.

Awards Won: