Optimization of a Microbial Fuel Cell System for Practicality, Versatility, and Affordability: The Future of Green Energy Production

Jeyagobi, Omanah (School: Sekolah Menengah Kebangsaan Jalan Empat)
Danial, Hana Qistina (School: Sekolah Menengah Kebangsaan Jalan Empat)
Yuzrinoor, Nur Qistina (School: Sekolah Menengah Kebangsaan Jalan Empat)

Microbial fuel cell (MFC) technology is gaining interest in the scientific community as a promising alternative energy source. However, current MFCs have several limitations. Therefore, this project aimed to optimize the MFC system by investigating internal and external factors that influence its performance. A series of five experiments was conducted. Experiment 1 compared two designs (MFC1 and MFC2) and showed that a large electrode surface area, a definitive proton exchange membrane and compartmentalized chambers effectively tripled the open circuit voltage (OCV) from 535mV to 1504 mV. Experiment 2 compared MFC2 to a plant-MFC (P-MFC) and discovered that the presence of living plants increased longevity by providing a constant supply of organic matter via rhizodeposition while enabling the MFC to perform optimally without anaerobic conditions. Experiment 3 observed the effect of temperature on OCV and proved that plants also act as thermal buffers. The internal temperature of MFC2 frequently spiked, causing drops in OCV to a minimum of 23mV. In contrast, the P-MFC maintained a stable internal temperature and OCV throughout the experiment. Experiment 4 showed the plant with a rhizomatous root system (Syngonium podophyllum) outperformed Gardenia jasminoides and Epipremnum aureum when applied in a P-MFC. Experiment 5 compared different soil:mud ratios and found that mud-based MFCs with optimized soil ratios, especially 1:3, produced higher and more stable OCV than MFCs with only one type of inoculum. The results provide compelling evidence that, with continued research and technological advancements, MFC technology has the potential for practical deployment beyond laboratory environments.

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