Effective Remediation of Air Pollution and Sustainable Electricity Production using an Algal Bio Photo-Voltaic Fuel Cell (BPFC), Phase III

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The Bio-Photovoltaic Fuel Cell (BPFC) is a promising new technology that generates clean electrochemical energy using the photosynthetic activity of organisms. However, existing BPFCs use expensive materials and yield low power outputs. Algal strains are known for their photosynthetic activity and fast reproduction rates and have become the ideal organism for BPFCs. Research in developing novel algal BPFCs has been limited to few microalgal strains like C. vulgaris and not much has been studied to improve photosynthetic efficiency of algae to increase power output. Flue gas derived bicarbonate generated from Carbon Mineralization (CM) is instrumental in boosting algal growth in certain strains. If bicarbonate can enhance algal exoelectrogenic activity, integrating CM with BPFCs could potentially lead to sustainable electricity production.

In this study, the exoelectrogenic activity of a macroalgae collected using standard field techniques and three (3) microalgal strains were studied. The experiment was conducted using BPFCs built using inexpensive, off-the-shelf materials to test the algal strains' responses to different concentrations of bicarbonate. Algal growth and voltage outputs were measured for a period of 7 days. Results indicate that exoelectrogenic activity was improved in all 4 strains with bicarbonate, resulting in voltage increase of 259±15% in macroalgae and up to 139±5% in microalgae. C. rugosum produced the highest voltage of 422±3.1 mV. In conclusion, flue gas derived bicarbonate addition in algal BPFC significantly increased algal exoelectrogenic activity and led to improved energy production thus serving as a possible method to reduce carbon emissions in power plants and produce clean energy.

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