The Creation and Optimization of a Plant Microbial Fuel Cell for Energy Generation Using Brassica rapa

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By 2040, the global consumption of energy is expected to increase by 28% from 2017. As the demand for energy increases, the demand for sustainable sources increases. The purpose of this study was to create and optimize a Plant Microbial Fuel Cell (PMFC) using Brassica rapa as a potential alternative energy source. PMFCs were created in 13-ounce containers with graphite felt attached to titanium wire as the electrodes and Brassica rapa seeds planted in soil. Square, circle, and octopus-shaped electrodes, distances of 3, 6, and 9 cm between the electrodes, inoculation of the anode with Escherichia coli k-12, the addition of Citrus sinensis (orange) peels, and connection of the cells in a series configuration were variables tested and optimized. Results showed PMFCs with circle electrodes inoculated with E. coli k-12 and placed 3cm apart with the addition of Citrus sinensis yielded the greatest average potential. Circle electrodes had the most efficient surface area use. Inoculation with E. coli increases the electron output due to the bacteria's electrogenic properties. A distance of 3 cm minimized internal resistance, and the addition of Citrus sinensis increased the amount of organic material available for decomposition, increasing the number of free electrons. Citrus sinensis peels served as waste material for the bacteria but can be substituted with any waste materials readily available in a region. This novel fuel cell is cost-efficient ($3.59 each- 5 times cheaper than a regular MFC to produce the same voltage) and utilizes easily attainable, natural resources, making it sustainable and usable in various environments.