Sulfur-Deplete Cultivation of C. reinhardtii: A Novel Approach to Increasing the Cost-Efficiency of Green Hydrogen Fuel Production

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Hydrogen fuel production is one of the most pressing issues that is preventing hydrogen fuel cells from becoming a green, cost-efficient alternative to fossil fuels. Currently, the cheapest method of producing green hydrogen (pure hydrogen gas with no associated carbon emissions) is by using hydrogen producing algae in sulfur-deplete environments. However, this process requires cultures of algae to be cultivated in a standard medium, centrifuged to isolate any sulfur-containing compounds, and processed to remove said compounds before any hydrogen fuel can be produced. This project serves to determine if it is possible to create a growth medium lacking sulfur compounds in which the algae C. reinhardtii can be cultivated and allowed to produce hydrogen gas, thus circumventing the process of centrifugation and eliminating the use of a second growth medium. Six cultures of C. reinhardtii were cultivated in a handmade photobioreactor in three different media: water, a standard tris-acetate-phosphate solution, and a novel sulfur-deplete medium created using cost-efficient compounds. All gases produced from these cultures were collected over water over the course of three weeks. The volume of the gases were recorded by measuring water displacement and the composition of the gas samples were tested for hydrogen presence using a lit splint to perform a ‘pop’ test. It was determined that the cultures grown in the sulfur-deplete medium did produce a notable quantity of hydrogen gas that could, without any further processing, be used to power a proton exchange membane hydrogen fuel cell.