Investigating Natural Hydrogels to Sustain Bioluminescent Algae for Sustainable Lighting and CO2 Removal

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This project aims to find natural solutions to reduce carbon dioxide contributing to climate change while expanding access to lighting. There Species of marine dinoflagellates, such as Pyrocystis fusiformis, can perform photosynthesis and bioluminescence, two processes that can be utilized to remove CO2 emissions and provide sustainable lighting sources. Previously, this species was applied to fabrics to create functional textiles. However, fabrics were determined to be unsuitable materials for this application, as they limited cell growth. The current study explored hydrogels as an alternative to sustain dinoflagellates. Hydrogels are common in medical applications relating to mammalian cells but have not been widely explored for these dinoflagellates. Hydrogels were synthesized from natural materials, such as alginate, carrageenan, and carboxymethyl cellulose (CMC), and tested at ratios of 1%, 2%, and 3% w/v. It was hypothesized that hydrogels would allow P. fusiformis to survive as they maintain moist conditions. Measurements included cell count, biomass, dissolved oxygen, and spectrophotometry after 1, 3, and 5 days. For the 3-day dataset, agar-agar and glycerin films in different concentrations were also tested. CMC hydrogels repeatedly showed high cell count and biomass, indicating higher cell density. However, none of the hydrogels displayed bioluminescence due to cell adhesion. Only the agar-glycerin films displayed bioluminescence, as they minimized cell adhesion. These films also showed high photosynthetic activity through oxygen readings. The data was analyzed with ANOVA and Tukey post hoc testing. In the future, glycerin-based films will be assessed further to maximize the growth and function of P. fusiformis.

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