CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

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Project Number

J1506

Project Title

Optimization of Biofuel Production from the Algae Nannochloropsis oculata

Abstract

Objectives/Goals

The demand for oil resources has grown astronomically in recent years. Several models predict that oil production will start to decline after 2020, leading to a shortage of resources and onset of a crisis. An alternative to energy shortages are algae based biofuels. Algae reproduces quickly, and research has shown that it yields at least 23X times more fuel than any other crop. The goal of my experiment was to investigate the optimal conditions for algal biofuel production. I used the algae strain Nannochloropsis Oculata and varied light conditions, air flow, and medium of water.

Methods/Materials

Several stock cultures of Nannochloropsis were prepared. Tests were done in triplicate with the independent variables of salt water, distilled water, and gray water, and the constants of temperature, air flow, amount of water; the dependent variable was the algal biomass produced. A second test in triplicate varied light conditions and a third test in triplicate varied the amount of air flow. The amount of algal growth under each of these conditions was measured. The ideal conditions were identified and these were used in unison to maximize algal growth and produce biofuel. Finally TLC was run on the biofuel produced and compared against vegetable oil.

Results

Salt water produced 15.9mg/400mL of algae, followed by DI water which produced 3.4mg and gray water which produced 0.4mg. The culture which was exposed to grow bulb alone produced 14.9mg while the other two with the grow bulb and an additional light source from 10cm or 15cm killed the algae. The culture with the aerator produced 15.7mg while the one with foam stopper and straw, and loosened cap and tape produced 5.2mg and 3.2mg respectively. Combining the optimal growth conditions produced 87.1mg of biofuel for 188.8mg of algae. The TLC analysis showed that the biofuel produced from algae matches that of vegetable oil.

Conclusions/Discussion

The ideal conditions for maximizing algae growth were identified and my hypothesis was supported. The biofuel produced showed a strong correlation to vegetable oil based on TLC which demonstrates that the biofuel produced is a viable energy source. Based on the data it was also extrapolated that we will be able to produce 50.8g of biofuel from a pond which is 2.5m x 1.5m x 0.7m. My experiment shows that optimizing the conditions of algae growth could play an important role in increasing biofuel production.

Summary Statement

My work shows how the factors affecting algae growth can be tweaked to optimize the production of algal biomass and biofuel.

Help Received

Used lab equipment at Schmahl Science Workshop under the supervision of Dr.Aru Hill