CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
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Project Number
S1401

Project Title
The Utilization of a Photobioreactor to Optimize the Growth Rate of Lipids in Microalga for Use in Biofuels

Abstract

Objectives/Goals
To optimize the growing conditions of the alga strain Neochloris oleoabundans at the lab scale and then in a photobioreactor to maximize lipid production and extraction for the practical use in biodiesel fuel.

Methods/Materials
After purchasing the strain Neochloris oleoabundans from UTEX, I utilized nutrients in solution with a ratio of 1:1:1 (nitrate:phosphate:potassium) to stimulate algae growth in glass cups under a fluorescent grow light. I wanted to find the ideal ratio of algae to nutrients so that the reproduction of the algae (and lipids) could be maximized and measured through the use of a chlorophyll meter. The optimized parameters were then applied to a larger-scale photobioreactor which I built, and this encompassed all the necessary components critical to sustained reproduction, such as constant access to light, abundant surface area, and steady aeration. The alga produced was dried through evaporation and 5mg was mixed with 1mL of a hexane solvent. The hexane combined with ultra-sonification released the lipids, and then the hexane solvent was evaporated using a centrifuge, thus leaving behind the extracted lipids.

Results
After doing the testing at a lab scale using the glass cups, I was able to find that the concentration of nutrients, 2mL of a nitrate:phosphate:potassium solution in a 1:1:1 ratio added to 350mL of water caused the greatest alga bloom out of all my samples, each of which began with 25ug/L of chlorophyll. 36 hours later, this alga bloom had grown to 4,800ug/L of chlorophyll, determined using the chlorophyll meter. This ratio was then applied to my photobioreactor in which I produced sufficient quantities of alga with a growth cycle of 4 days. The harvested alga was dried and the oil extraction procedure revealed that the lipid makes up approximately 20% of the algae#s total mass, all of which can be extracted for transesterification into a biodiesel fuel.

Conclusions/Discussion
In conclusion, lipid production can be enhanced and sustained through the manipulation of variables, specifically the concentration of the nutrients nitrate, phosphate and potassium. By metering the nutrients into the photobioreactor as determined by the lab scale growth rates, the optimum ratios were maintained through a 4 day growth cycle. This allowed me to harvest the maximum amount of algae, and thus extract 20% of the algae#s mass in the form of a lipid.

Summary Statement
The manipulation of nutrients to maximize the growth rate of Neochloris oleoabundans so that it can produce the highest yield of lipids to be extracted for use in biodiesel fuel.

Help Received
Dr. Hossein Ahmadzadeh, Professor at Cal Poly Pomona, oversaw oil extraction, father helped build photobioreactor, mother helped glue the board