CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
Erin S. Lee

Project Number
J1722

Project Title
Powering Up Your Home with Green Energy

Abstract

Objectives/Goals
To see if green algae can be tricked into producing H(2) via photosynthesis and the optimal conditions for maximum production. I will also determine whether this H(2) can be a viable energy source.

Methods/Materials
Green algae kit (containing Chlamydomonas cultures) was ordered from the Chlamy Center (Duke University, Durham, NC) Algae was grown in 1 of 4 conditions, all under a 60 watt bulb 24/7: "Control" - left alone, "Variable 1" - "fed" CO(2) daily, "Variable 2" - spun constantly, and "Variable 3" - "fed" and spun. The algae was induced to produce H(2) by being put into anaerobic and sulfur-deficient conditions. The algae was centrifuged and washed in sulfur-deficient media. The volume of O(2) and H(2) produced was measured separately by recording the pressure increase in an airtight bio-reactor and converted to volume (ml) of H(2). Electricity from the H(2) produced by the algae was made using a fuel cell.

Results
The optical density of 4 bottles, or the amount of algae, was measured repeatedly during 3 months. The worst condition was the control, which was approx. 5 x 105 cells per ml. None of the other conditions reached Variable 3's peak density (approx. 5 x 106 cells per ml). O(2) production from algae was much more than H2 production (9 vs. 1.8 ml/day, respectively). Gas production was linear in increase (r2 of .94). The amount of electricity produced per ml of H(2) from both electrolysis and algae was recorded using an ammeter. H(2) produced from electrolysis produced almost six times more electricity per ml than H2 from algae. However, both methods produced very little electricity - electrolysis produced 1.7 mW and algae produced 0.3 mW. Lastly, the cost of 1 KWH of electricity from 4 different sources was calculated. One KWH from LA DWP costs $0.13; from electrolysis was $0.80; from algae ranged from $1.06 to $30.58 depending on how the H(2) was collected.

Conclusions/Discussion
The cost of making electricity from algae-generated H(2) is 6-8 times higher than electricity from fossil fuels. However, H(2) could be a valuable energy source in the future if the amount of H(2) produced from algae could be made more efficient, and/or the price of fossil fuel electricity goes way up. Since we have a limited source of fossil fuels, a home of the future would most likely be powered by a combination of renewable sources, including H(2) from algae.

Summary Statement
My study showed that green algae can be tricked into producing hydrogen and this hydrogen can be used to produce electricity using a fuel cell.

Help Received
Dad soldered wires for fuel cell, Chlamy Center advised on growing of algae