# An Introduction to the Use of Algae as a Biofuel in Place of Fossil Fuels

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**Summary**

Algae are aquatic, plantlike organisms that exist in different forms. The present research focuses on microalgae, a unicellular form of the organism. Research in microalgae has mainly focused on conversions into biofuel. In this work, the growth and production of microalgae was monitored in a photobioreactor. The intent of this research was to extend current knowledge regarding algae conversion into biofuel for the purposes of replacing fossil fuels in the future.

**Introduction**

Today, one of the greatest issues faced by society is the shortage of fossil fuels. Fossil fuels are hydrocarbons which take millions of years to form. They are used for creating energy and electricity and have been vital for our cultural development. Fossil fuels include coal, petroleum, and other natural gasses. The central problem is that the need for fossil fuels far outweighs their production [4]. For example, society has become reliant on petroleum, especially for automotive transportation.

Fossil fuels also have many other drawbacks, such as the release of large amounts of carbon dioxide into the environment when burned. Researchers have attempted to find various resolutions to this problem, which led to the research in renewable forms of energy and fuel. Windmills, watermills, solar panels, hydroelectric, and biomass are some of the developments of renewable energy [4]. A breakthrough occurred when researchers found that corn could be used to make a fuel called ethanol [2]. Corn was not an ideal solution because it is a food source and does not produce a large amount of ethanol. Researchers needed to find a source of fuel that was renewable, environmentally friendly, and would also produce large yields.

Algae meet these requirements. They can be used to make renewable biofuels that do not harm the environment [3]. Also, photobioreactors used to grow algae recycle carbon dioxide and can be used to help moderate the carbon dioxide emitted by large fossil fuel burning stations. This four year, ongoing, experiment focuses on the collection of data regarding the efficient and healthy growth of algae. This article analyzes three months of data collection during the summer of 2012, in which there were two main goals: to demonstrate high concentration of algae production in the photobioreactor, and to increase the efficiency of collecting dry algae product after harvesting.

**Methods**

To survive naturally in an open system, algae require only carbon dioxide, sunlight, and water. When grown in a closed system, such as a photobioreactor, nutrients must be manually inserted [1]. The photobioreactor tank had an artificial light and was attached to oxygen pumps. Every day, distilled water and carbon dioxide were added to the tank. Detergent was also added to avoid parasitic infestation in the tank. Along with this manual maintenance, daily light distribution tests measured the algae's diffused optical density (DOD), or concentration of algae in the tank. This parameter is a ratio of the light streaming through a water jar compared to the light streaming through a jar of algae sample. A higher DOD represented a greater algae concentration.

Another important aspect of the project was the harvesting of the algae, which occurred through a series of separating processes. Dead algae were extracted from the tank by a pump and tabletop separator. They were then poured into smaller separating funnels, with the dead algae collected into bottles to be dried. The gross dry mass of the harvested algae was then recorded and monitored over time.

**Results**

As can be seen in Figure 1, the daily DOD light calcula-

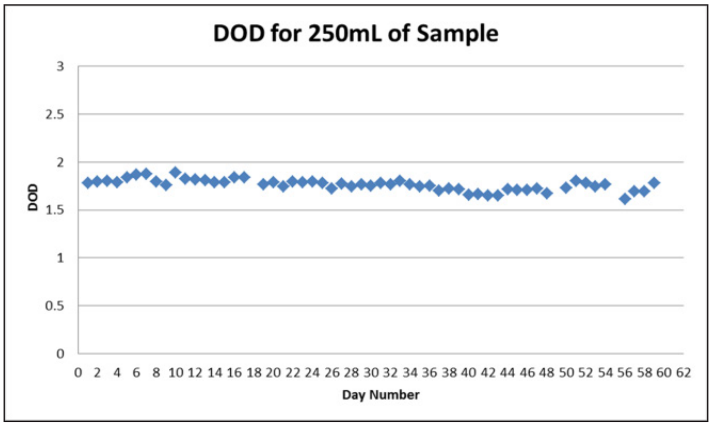

**Figure 1.**

tions for 250mL of water and algae sample remained relatively constant throughout the experiment, while the grams of dry algae collected per week during the experiment increased, especially after week 6, as can be seen in Figure 2. During a weekly cleaning of the tank, it was observed that the dead algae that had settled on the bottom of the tank could be circulated using a cleaning wand. This led to a new routine of stirring the tank every other day which resulted in the increase in harvested algae. In order to determine whether the increase in gross algae mass was correlated with stirring the algae tank, which began at week 6 in the experiment, a point-biserial correlation was calculated, based on 27 observations ( 9 weeks at 3 times per week), between whether or not the tank was stirred and biomass. There was a .38 correlation which is statistically significant at $p<.05$, including that stirred samples had greater biomass than unstirred samples.

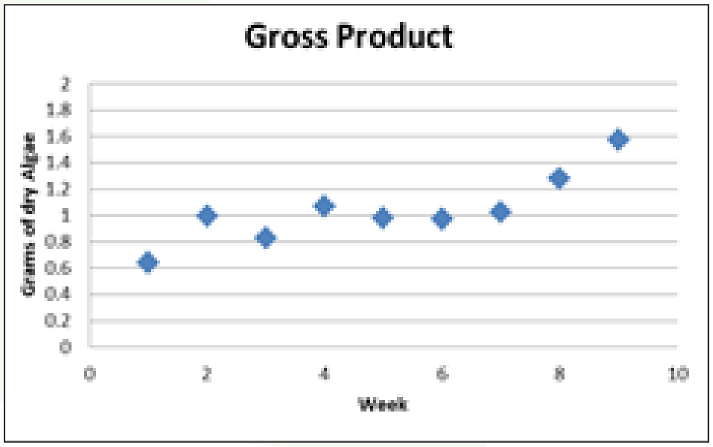


**Figure 2.**

### Discussion

The light distribution calculations (DOD) remained fairly constant throughout the project. The rise and fall of the ratios could be attributed to daily differences in the amount of carbon dioxide provided to the algae. Figure 2, which depicts the amount of algae harvested during the project, shows an increase in product. The exponential increase starting after the seventh week had to do with a new routine of stirring the tank. Each day after the sixth week, the tank was stirred to cause the dead algae settling at the bottom to circulate through the separators. There was a statistically significant increase in biomass represented by the positive correlation calculated in results. Although there was an increase in dry algae produced, 1.6 grams is not a substantial amount to be harvested over one week.

Due to the fact that research in algae as a replacement for fossil fuels is a fairly new idea, there is much room for development and improvement in the future. Some techniques that were discussed as a result of the developments of this project are, stirring the tank on a daily basis, new air filters to keep the dead algae from settling at the bottom of the tank, and a regulated time for DOD readings. A regulated time for DOD readings would insure that the variable due to light would be relatively constant, therefore not altering the results. The next step that will be taken in this project is a new strand of algae that has higher product expectancy.

### Conclusion

According to the results of the experiment depicted in Figures 1 and 2, the goals of the project were met. The calculated DOD remained constant enough, with a range of 0.5. The gross product of dry algae collected increased to 1.6 grams, a substantial change representing an increase of 1.0 g above the initial measurement. This is also proved by the point-biserial correlation of .38 which is statistically significant $p<.05$.

### References


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[3] Demirbas, A. Progress and recent trends in biofuel. Progress in Energy and Combustion Science. 33:1-18, 2007.