Understanding and Controlling the Growth of Algae Species on Nanocomposites.

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Abstract

Due to the increased media attention on climate change and the negative impacts of fossil fuels on the environment, many petrochemical companies are turning to alternatives to fossil fuels. Biofuels are ideal candidates to replace fossil fuels because they lower CO_2 emissions. Algae stand out as one of the most versatile sources of biofuel. In nature, multiple species of algae grow together in groups on rocks and other surfaces. In industry, situations arise in which it is necessary to produce only one species of algae. This project focuses on two species of filamentous algae: *Microspora* and *Oedogonium* (Figure 1). *Microspora* is an algae which can be used in contaminated waterways for heavy metal clean up, and *Oedogonium* is potentially useful as a biofuel. By understanding the growth and attachment of algae, specific substrata could be made that would only grow one algae species each. The goal of this research is to understand the attachment and growth of algae on nanocomposites that are made from polylactic acid (PLA) and cellulosic materials.

Introduction

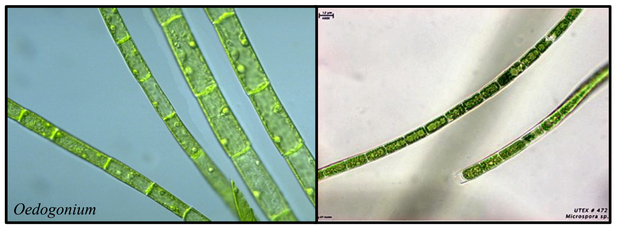

Figure 1. Filamentous alga species used in our experiments.[1,2]

- Biofuels are produced from the fats and oils of living organisms.
- Algae can grow rapidly in extreme conditions.[3]
- Algae yield higher fuel per unit area growth, makes them ideal biofuel.[4]

The Biofuel Process

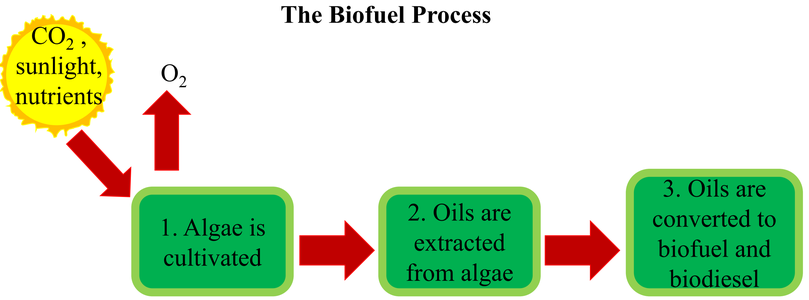

Figure 2. Energy rich compounds can be extracted from the biomass of biofuel crops to make biofuel as well as biodiesel.

- Naturally algae species grow together, not one species alone.
- It would be useful to grow one species of alga alone, to increase yield of most desirable products

Discussion

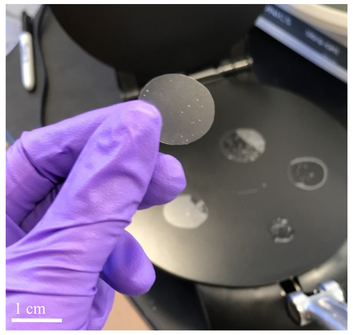

Figure 3. A sample of pure PLA that has been pressed into a disk.

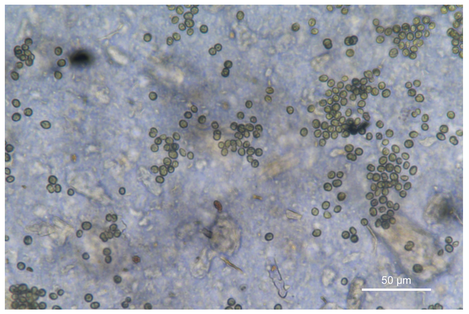

Figure 4. A sample of pressed PLA-8 wt% PEO composition- viewed under a microscope.

- Algae prefer textured surfaces with spaces approximately the diameter of the algae cell.[5]
- A flat pressed disk of the PLA composite must be made for attachment (Figure 3).
- 10-200 cells adhere to our selected surfaces (Figure 4).

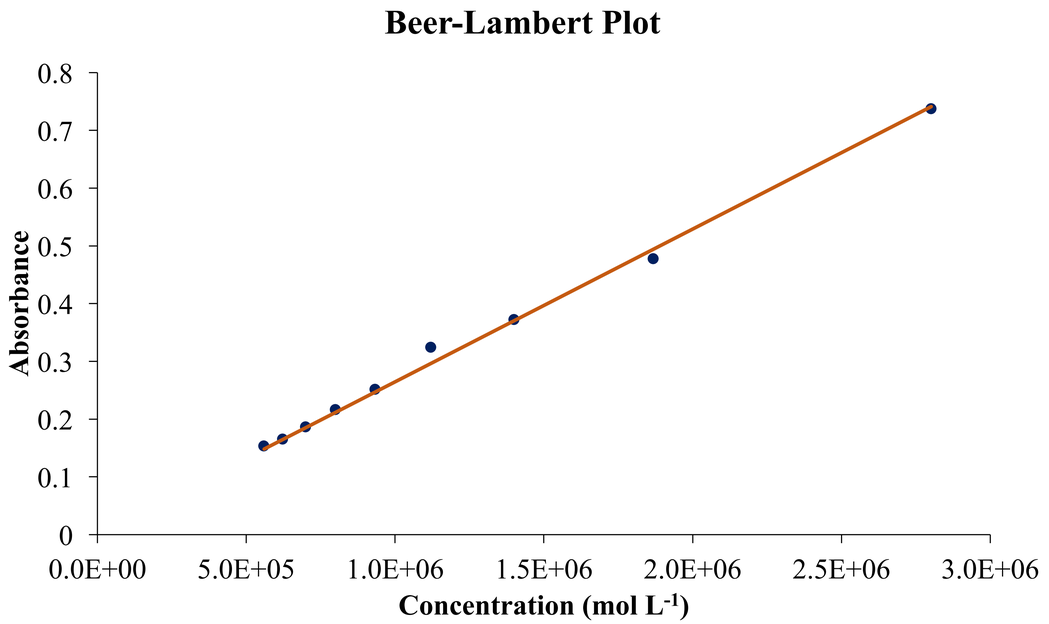

Figure 5. Graph of absorbance vs. concentration of algae. Equation: $y = 3\times10^{-07}x$; $R^2 = 0.99607$

Equation 1. Calculating Molar Extinction Coefficient*

$$Beer's\ Law: A = \varepsilon\, l\, c$$

Slope = $\varepsilon\, l = 3\times10^{-07}$ l = 10mm pathway

$\varepsilon = 3\times10^{-08}$ L mol^{-1} mm^{-1}

*See Figure 5

Methods

- Two methods for measuring algae concentration: hemocytometer and UV-Vis spectroscopy.
- UV-Vis spectroscopy uses Beer-Lambert law (Figure 5).
- The molar extinction coefficient of algae is 3×10^{-08} L mol^{-1} mm^{-1} (Equation 1).
- Hemocytometer method requires cells to be hand counted.
- The algae concentration was found to be 5.603×10^{6} cells/mL.

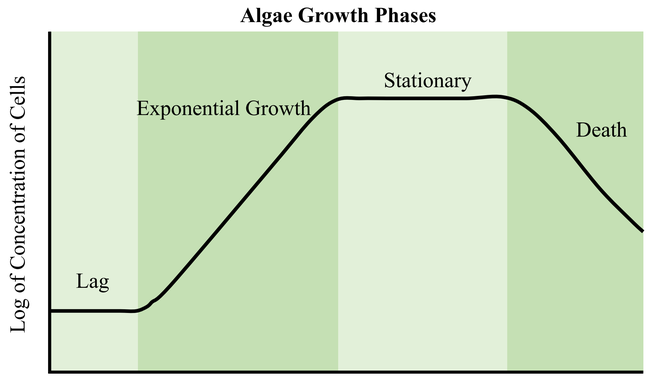

Figure 6. Stages of cellular growth of algae.

- Hemocytometer method is inaccurate with large algae cultures.
- Algae growth goes through phases (Figure 6).

Conclusions

- The UV-Vis spectroscopy method yields the same results as the hemocytometer counting method.
- UV-Vis provides a faster method for monitoring algal cultures.
- A model planktonic algae (S. Dimorphus) can attach to PLA and PLA compounds.

Future Work

- Observing algae attachment on varied composites of PLA and cellulosic materials in stagnant and flow environments.
- Understand effects of substrate on the attachment of different algae.

Acknowledgements

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