Algal Bioplastics: Developing a Sustainable Cycle of Compostable and Water-Soluble Plastics by Repurposing Waste Products of Algal Biofuel Production

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The purpose of this research was to determine the sustainability of algae-based bioplastics as alternatives to petroleum-based plastics. In Part I of experimentation, four different algae species were grown in a homemade photobioreactor. After monitoring growth with hemocytometry, the algae species were harvested, and the algal lipids were separated from the algal biomass and converted to biodiesel via mechanical extraction. The resulting biomass was dried, ground, and used to make bioplastics. In Part II of experimentation, Chlorella vulgaris (determined to be the optimal algae species from Part I) was used to make 5 types of bioplastics with varying percentages of biomass to starch ratios (0%, 25%, 50%, 75%, and 100% biomass). Plastics were made with a recipe of algal biomass, starch, vinegar, glycerol, and heat. Bioplastics were tested for biodegradability, water solubility, strength, and ability to increase plant growth as a natural fertilizer. Results indicated that higher percentages of algae biomass resulted in faster water dissolution, increased biodegradation in soil, and higher plant growths. Bioplastics with 25% biomass performed best in testing overall, supporting 633 grams, losing 19.2% mass in water after 7 days, losing 97.5% mass after biodegrading in soil, and increasing plant yields by 46% and 28.5%, in pea and radish plants respectively after 10 days. Results suggest higher percentages of starch would increase success in strength tests. With adjustments to starch/biomass ratios, environmental impacts and strength can be manipulated to suit intended use of bioplastic. Algal bioplastics show promise as sustainable solutions to the plastic pollution crisis.

Awards Won:

Second Award of $1,500

Air Force Research Laboratory on behalf of the United States Air Force: First Award of $750 in each Intel ISEF Category

National Oceanic and Atmospheric Administration - NOAA: Second Award of $500