CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Nicolas Laqua; Annam Tran

Project Number

S1810

Project Title

Novel Transfection of Macroalgal Azolla and Lemna Mediated by Agrobacterium to Elevate Neutral Lipid Biofuel Production

Abstract

Objectives/Goals

This affiliated research delves into genetic modification of the aquatic duckweeds Azolla caroliniana and Lemna minor in order to elevate triacylglycerol, diacylglycerol, wax ester, and other long chain lipid production for the purpose of biofuel production. These macroalgal duckweeds Azolla and Lemma were selected for a magnitude of reasons, including reduced difficulty of reliable harvest and rapid growth employed by both Azolla and duckweed. In order to catalyze potential biofuels, we transferred our gene of interest, bifunctional wax ester synthase/acyl-CoA diacylglycerol acyltransferase or atfA1, the key to biosynthesis of storage lipids in Acinetobacter sp. strain ADP1 located within the enzyme WS/DGAT, into A. tumefaciens strain pET21a-IfeR to allow catalyzation formation of triglycerides and WE from DAGs and fatty alcohols: Our research isolated and transformed A. baylyi ADP1's WS/DGAT into modified Agrobacterium tumefaciens pET21a-IfeR, acting as a vector for our goi, and isolated from Acinetobacter baylyi ADP1 via gel purification after electrophoresis and restriction digest. A. tumefaciens then transfected WS/DGAT into Azolla via novel spore propagation, and duckweed via calli induction. Upon utilizing Agrobacterium tumefaciens novelly for modification of Azolla, and performing modification of Lemna via calli induction andexposure to A. tumefaciens, both species# fatty acid production was statistically elevated. The product of processed duckweeds was utilized after solvent-lipid fsaa extraction; we converted our extracted lipid into functional biodiesel by transesterification. TAG production elevated an average 10% in the transfected L. Minor samples; 7% in treated Azolla samples. Functional biodiesel production was obtained from the rapidly growing azolla and duckweed in the form of neutral lipids at a rate deemed "percent efficiency" or production efficiency: Dry weight percentage of long chain neutral lipids usable in biodiesel. The term "percent efficiency" (pe) models the elevation of fatty acids, increasing from 10.1 to 18.7 and 14.2 to 16.8, (Lemma /Azolla respectively). Based upon our experiment, A. caroliniana, and to a greater extent L. minor, are vectors for elevated fatty acid production, serving as a backbone for continued research into renewable, reliable, carbon negative biodiesel production from fast growing macroalgal sources.

Summary Statement

Through novel processes we transfected two species of macroalgal duckweed, Azolla caroliniana and Lemna minor, in order to elevate long chain lipid production for the purpose of biodiesel production.

Help Received

All research was done in the Canyon Crest Academy QUEST Laboratory with contributions from Thermo-Fisher Scientific, United States Biological Life Sciences, The Addgene Repository, and CCA Foundation. Funding and donations for Gel electrophoresis supplies, restriction enzymes, live cultures,