CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

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Project Number

S0526

Project Title

Induction of Endosymbiotic Gene Transfer from Chloroplast to Nuclear Genome in the Green Alga Chlamydomonas reinhardtii

Abstract

Objectives

-Create a positive control for the genetic cross by electroporating CC4696+ cells with the rbcL gene and isolating colonies that have been functionally complemented.
-Optimize Chlamydomonas mating protocol and efficiency as well as transformation efficiency.
-Develop and conduct a nature-imitating system to observe and characterize an endosymbiotic gene transfer event of the endogenous rbcL gene from the chloroplast to the nuclear genome.
-Compare the gene expression and genotypes of the transformant, wild type, and genetic cross colonies and analyze their differences.

Methods

-Several strains of algae were obtained from the Chlamydomonas Resource Center, including CC4696+, 21gr-, crCDA+, and cmj030-.
-Algal cultures were grown from TAP plates and minimal media TP plates.
-Several trials of electroporation were conducted on CC4696+ to manually insert the rbcL gene into the nuclear genome.
-High throughput genetic crosses were conducted to yield progeny that only survived negative selections on 5-fluorocytosine and spectinomycin antibiotic only if they had undergone endosymbiotic gene transfer.

Results

-Photoautotrophic CC4696+ transformants with the rbcL gene were isolated.
-Functionally complemented CC4696+ transformed with rbcL has a reduced photosynthetic capacity compared with the wild-type strain.
-A strain of crCDA- was acquired through mating type isolation PCR and tetrad analysis that can be used for further experimentation.
-The crCD gene has a sensitivity escape rate of approximately .4%

Conclusions

Several colonies of interest have presented themselves as promising candidates of endosymbiotic gene transfer events, but have yet to be fully confirmed through genetic crosses.While rbcL is an essential functional gene, other chloroplast genes are more metabolically taxing than they are functional. By exploring the naturally selective nature of EGT in integrating solely functional chloroplast genes, it opens an avenue to potentially optimizing photosynthetic systems and food crop yields.

Summary Statement

I recreated the macroevolutionary process of endosymbiotic gene transfer with high throughput transformations and genetic crosses via sexual reproduction.

Help Received

I designed and conducted this project individually, but had the supervision and advice of Professor Robert Jinkerson and Elizabeth Hann of the Jinkerson Lab at UC Riverside where I carried out my experimentation.