Synthetic Algal Promoters as a Tool for Increasing Nuclear Gene Expression in Green Algae

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BACKGROUND

Algae have enormous potential as bio-factories for the efficient production of a wide array of high-value products, and eventually as a source of renewable biofuels. However, tools for engineering the nuclear genomes of algae remain scarce and limited in functionality, in part due to lack of strong promoters.

TECHNOLOGY DESCRIPTION

Researchers from UC San Diego generated synthetic algal promoters (SAPs) as a tool for increasing nuclear gene expression and as a model for understanding promoter elements and structure in green algae. This invention provides synthetic promoters capable of promoting and/or initiating transcription of a polynucleotide in an algal cell, and methods of designing, producing and using such promoters

More specifically, promoters were generated to mimic native cis-motif elements, structure, and overall nucleotide composition of top expressing genes from *Chlamydomonas reinhardtii*, a green microalga. Twenty five SAPs were used to drive expression of a fluorescent report in transgenic algae. A majority of the promoters were functional ***in vivo*** and seven were identified to drive expression of the fluorescent reporter better than the current best endogenous promoter in *C. reinhardtii*, the chimeric hsp70/rbs2 promoter. Further analysis of the best synthetic algal promoter, sapl 1, revealed a new DNA motif essential for promoter function that is widespread and highly conserved in *C. reinhardtii.*

APPLICATIONS

These promoters could be used to drive the expression of high-value protein products in algae such as nutriceticals and therapeutic proteins. Synthetic promoters could also be used to express metabolic enzymes for the engineering of algal strains for increased growth or production of biofuels or other chemical products

ADVANTAGES

The data demonstrates the utility of synthetic promoters to drive gene expression in green algae, and lays the groundwork for the development of a suite of SAPs capable of driving the robust and complex gene expression that will be required for algae to reach their potential as an industrial platform for photosynthetic bio-manufacturing.

STATE OF DEVELOPMENT

To date, synthetic promoters have been shown to drive the expression of multiple genes of interest in Chlamydomonas reinhardtii including the fluorescent reporter mCherry, the industrial enzyme xylanase, and the therapeutic protein Granulocyte-colony stimulating factor (GCSF).

INTELLECTUAL PROPERTY INFO

This technology has a published patent and is available for licensing into commercial products

RELATED MATERIALS

- Anderson, MS, TJ Muff, DR Georgianna, SP Mayfield. Towards a synthetic nuclear transcription system in green algae: Characterization of Chlamydomonas reinhardtii nuclear transcription factors and identification of tar... Publication date 2017/3/31. Journal Algal research, Volume 22: 47-55 - 03/31/2017

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Published Application	2019/0382779	12/19/2019	2016-186
Patent Cooperation Treaty	Published Application	2017143080	08/24/2017	2016-186

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OTHER INFORMATION

KEYWORDS

Chlamydomonas reinhardtii, recombinant proteins, biofuels, bio-products, molecular engineering, Chlamydomonas, transcription factor, nuclear gene expression, RNA-sequencing, Yeast one-hybrid system, synthetic biology, green algae

CATEGORIZED AS

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