Overexpression of cyanobacterial hydrogenase to increase biomass productivity in the dark

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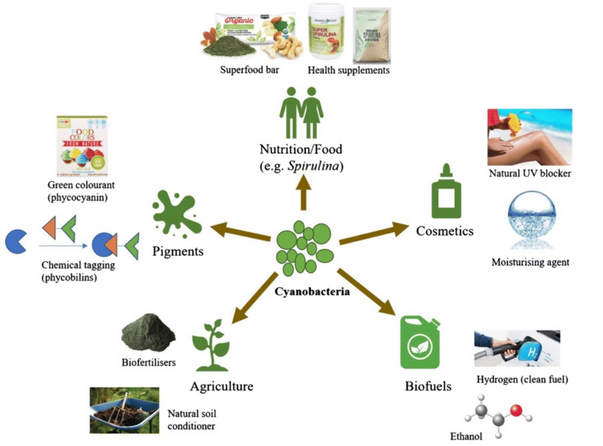
Background

Cyanobacteria, also called blue-green algae, are microscopic organisms found naturally in all types of water. These single-celled organisms live in fresh, brackish (combined salt and fresh water), and marine water and they use sunlight to make their own food.

- Potential source of biofuels, particularly biohydrogen and biodiesel, as they can produce lipids and other substances that can be converted into biofuels.
- It can produce biodegradable plastics as part of their metabolic processes.



Source: https://link.springer.com/article/10.1007/s40726-020-00140-w

Challenges

They face limitations in biomass productivity during periods of darkness, hindering their potential as sustainable bioproduction platforms.

Research Aims

Enhance the biomass productivity of cyanobacteria during dark periods by overexpressing the cyanobacterial hydrogenase enzyme. The aim is to improve the overall energy efficiency of cyanobacterial growth, offering a sustainable and efficient bioproduction approach.

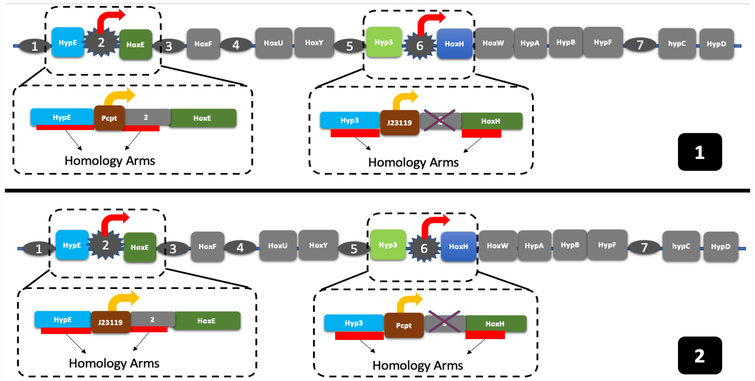


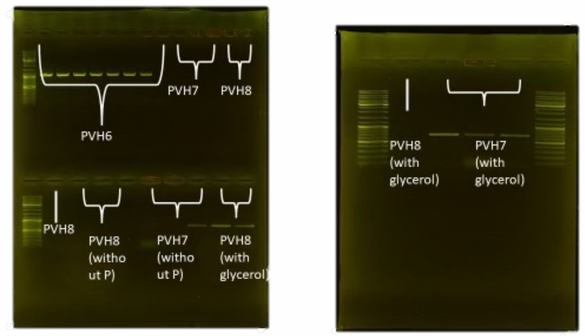
Figure 1: Gene Overexpression

Approach

1. Strain Selection - cyanobacterium *Synechococcus* sp. PCC 11901, with a rapid doubling time and high expansion capacity
2. Gene Overexpression - Two powerful synthetic promoters, Pcpt and J23119, will be used to replace the natural promoter of hydrogenase genes (HoxE and HoxH), leading to the overexpression of the hydrogenase complex
3. Transformation - Synthetic plasmids containing the desired promoters and genes will be used for the transformation of *Synechococcus* 11901.
4. Segregation - The transformed strains will be cultivated on antibiotic-containing plates to ensure the successful insertion of the synthetic promoter into their genomes.
5. Comparative Analysis - The altered strains will be compared to the parent strain in terms of chlorophyll content, biomass productivity under varying light intensities, and growth with H_2 and CO_2 supply.

Results

Figure 2: Culturing cyanobacteria through plates



(a) (b)

Figure 3: Gel Electrophoresis results for integration of a strong promoters in the native region of PCC 11901 in a and b

Future Directions

Several plasmids are constructed, and the construction of the remaining plasmids is ongoing.

Acknowledgment

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FURI

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