Simultaneous Production of D-Lactate and Ethylene by Engineered Cyanobacteria

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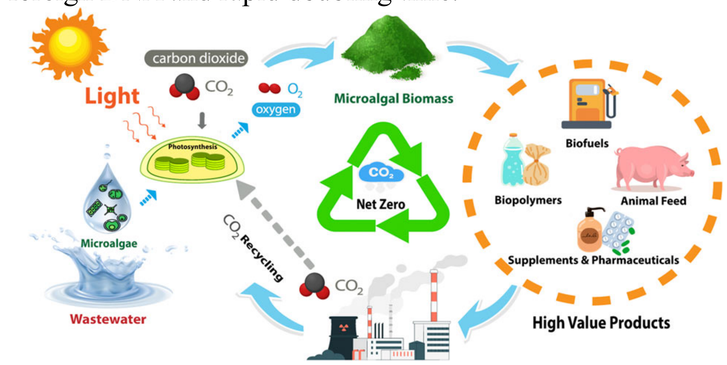
Background

Cyanobacteria has the potential to efficiently convert CO_2 into valuable biochemicals through photosynthesis. They can be used to produce lipids and other substances that can be converted into biofuels. Cyanobacterium *Synechococcus* sp. PCC 6803 was selected due to its natural ability to accept foreign DNA and rapid doubling time.



DOI: https://doi.org/10.3389/fbioe.2022.904046

Challenges

Previous work has separately engineered cyanobacteria to produce D-lactate and ethylene. However, producing only one chemical may not be economically viable.

Research Aims

To enhance its economic potential, this research project aims to demonstrate the co-production of D-lactate and ethylene using cyanobacteria strain, *Synechocystis* sp. PCC 6803.

Approach

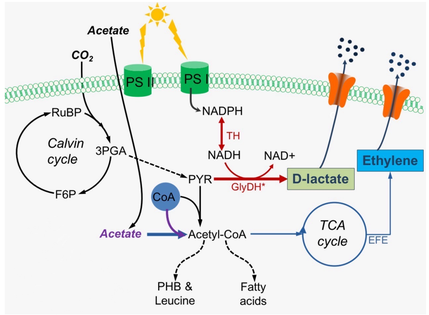


Figure 1: Metabolic Pathway for D-lactate and Ethylene production

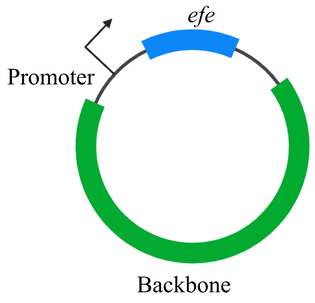


Figure 2: *efe* integration to wild-type and D-lactate producing strains using CRISPR-Cas to produce ethylene and D-lactate

1. Strain Selection - Cyanobacterium *Synechococcus* sp. PCC 6803 was selected due to its natural ability to accept foreign DNA and rapid doubling time.
2. Gene Integration – *efe* will be integrated to wild-type and D-lactate producing strains using CRISPR-Cas.
3. Transformation – Plasmids containing the desired *efe* gene will be utilized in the transformation of *Synechococcus* 6803.
4. Segregation – Transformed strains will be cultured on plates containing appropriate antibiotics to guarantee successful gene insertion.
5. Result Analysis – Titers must be determined for D-lactate and ethylene. Since D-lactate is a liquid, it will require HPLC analysis while ethylene will require GC-FID analysis since it's a vapor.

Results

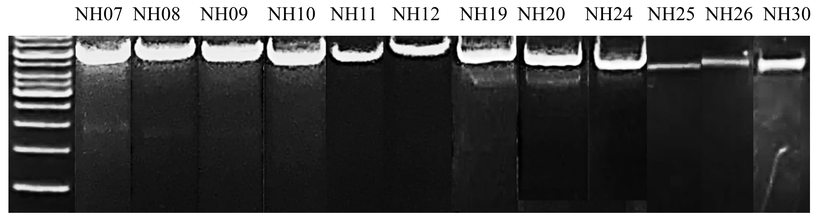


Figure 3: Gel Electrophoresis results for *efe* gene integration to PCC 6803.

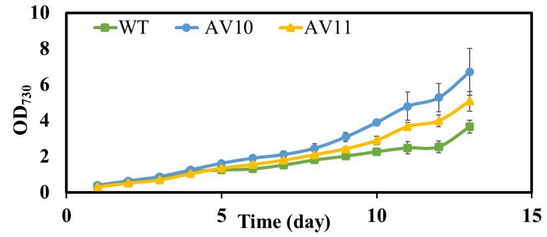


Figure 4: Optical Density measurements of AV10 and AV11, cyanobacterium previously engineered to produce D-lactate, over 13 days.

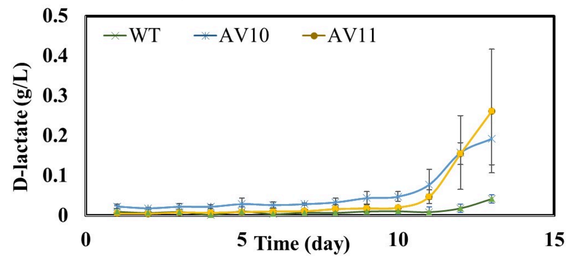


Figure 5: D-lactate titers of AV10 and AV11, cyanobacterium previously engineered to produce D-lactate, over 13 days..

Acknowledgements

Thank you to Dr. Arul Varman and Nima Hajinajaf for their mentorship and everything I have learned from working in lab.
Thank you to the FURI committee for the provided funding.

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Ira A. Fulton Schools of Engineering
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