Optimizing methanotroph biotechnology through growth strategies and strain adaptation

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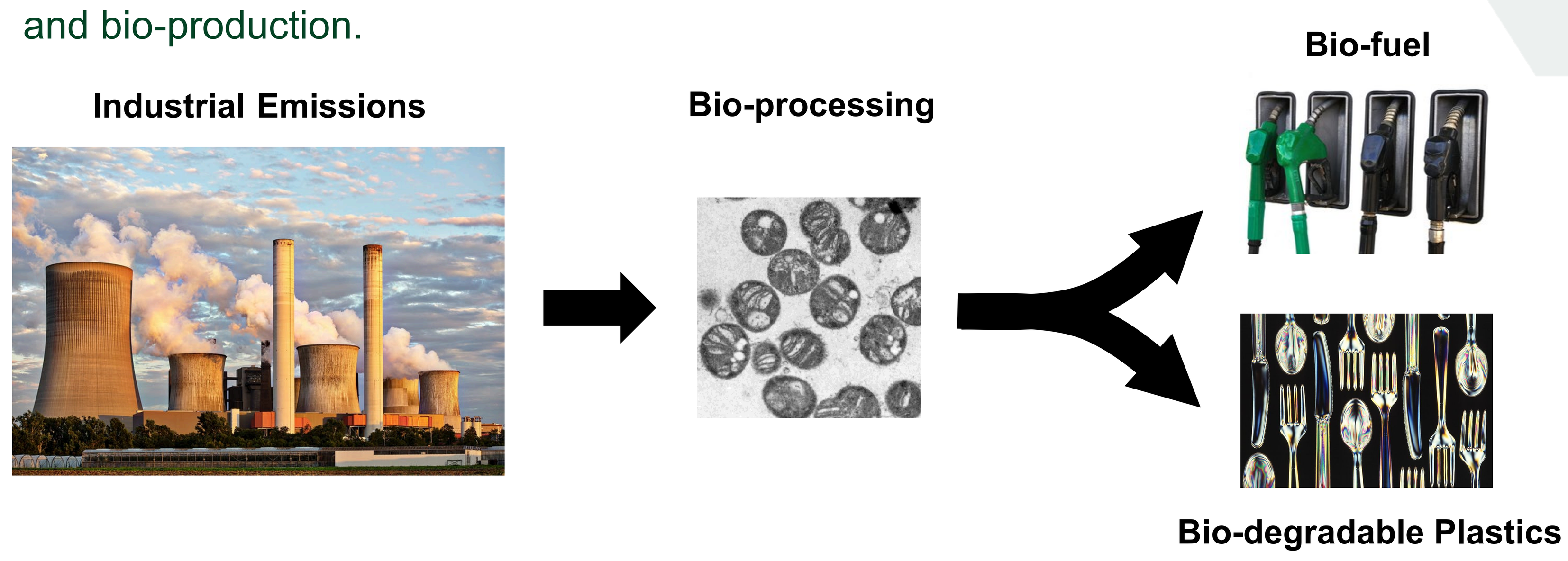
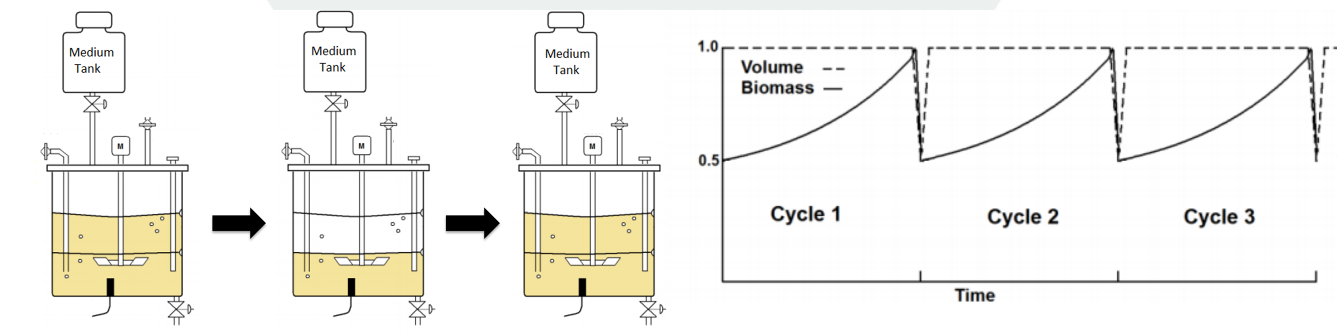
BACKGROUND

- Methane is a potent greenhouse gas, approximately 25 times more effective than carbon dioxide at trapping heat in the atmosphere.
- Methanotrophs, a type of bacteria that consume methane as their sole carbon and energy source, can be used for bioconversion of industrially emitted methane into valuable products.
- Optimization and refinement are required to achieve a bioprocess with optimal growth and bio-production.

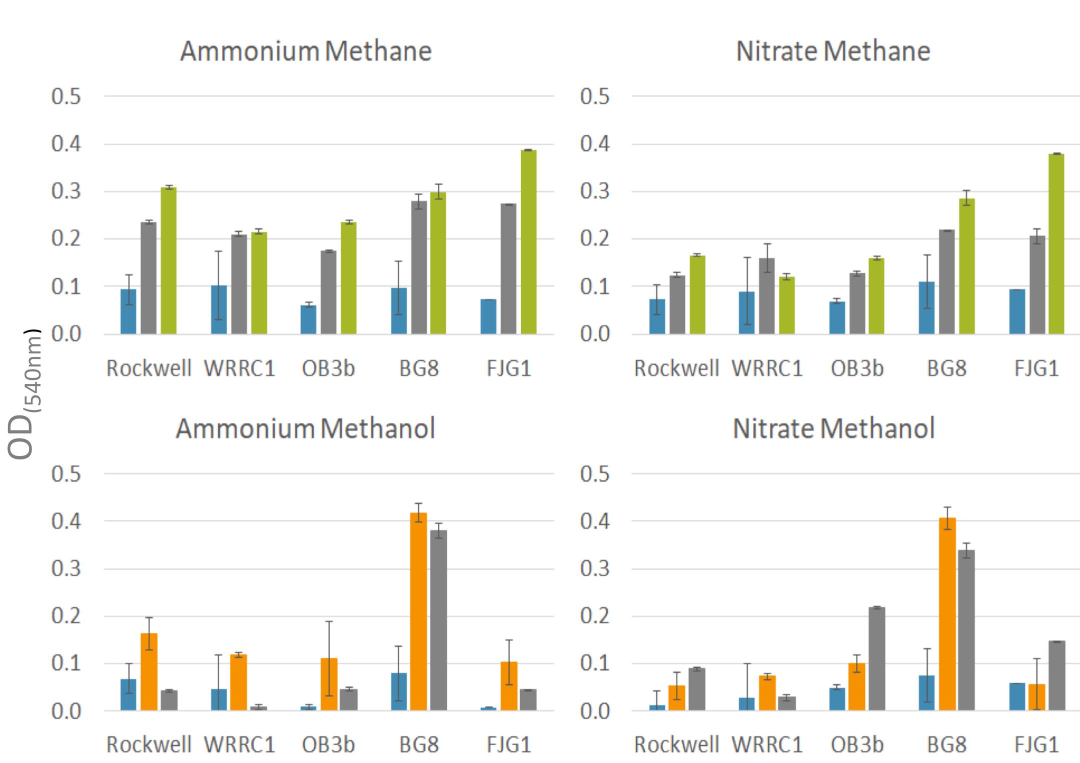


AIMS AND OBJECTIVES

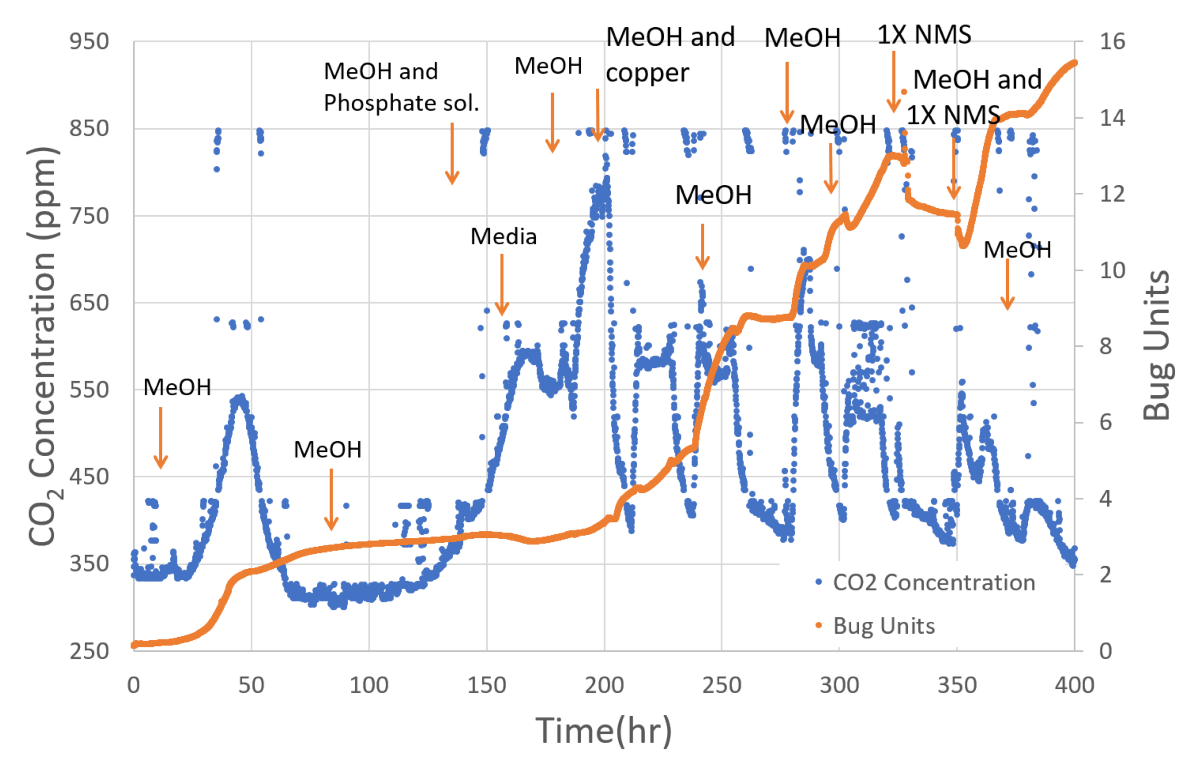
- Optimization of bacterial growth by the assessment of growth parameters under various nutrient conditions and identifying the best candidates for industrial application.
- Optimization of productivity and yield of the bioprocess through advancement of bioreactor growth strategies such as fed-batch and self cycling fermentation (SCF).
- Improving growth kinetics and increasing survival of the bacteria in industrial conditions – e.g. growing in acidic conditions of forestry industry - by implementation of strain adaptation strategies.



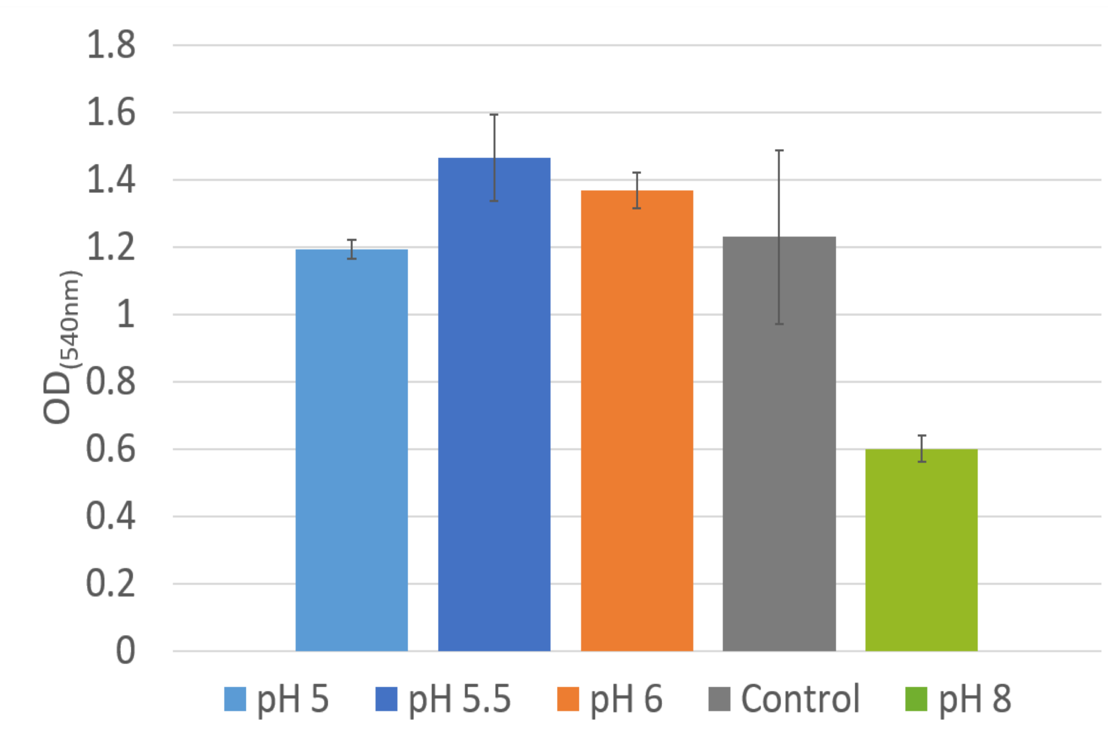
RESULTS



Biomass accumulation in different methanotrophic strains under different nitrogen/carbon conditions, with carbon provided at either 0.5 mmol, 1 mmol, 2 mmol, or 2.5 mmol per 100 ml of liquid cultures.



Effect of copper and nutrient addition on growth of *M. album* BG8 in a fed-batch process.



Effect of pH on growth in *M. album* BG8 given nitrate as N source and methane as C source. Similar experiments have been completed with methanol and ammonium.

FUTURE DIRECTIONS

To result in a truly optimized process of C1 bioconversions, more work in a variety of areas will be completed. These will include:

- Optimal ratios of copper to methanol will be used to obtain modified fed-batch and self cycling fermentation strategies to enhance the capacity of these processes towards industrialization of methane bioconversion using methanotrophic bacteria.
- After selection of optimal strain and condition, translation into bioreactor strategy for the production of value added products, such as isoprenoids and polyhydroxybutyrate (PHB).
- Strains will be adapted to less favourable conditions such as lower pH and forestry industry effluent stream.
- Once significant adaptation has occurred, genome sequence analysis will be performed to identify mutated genes that lead to favourable adaptations.

OVERALL PROCESS

FES PROJECT OVERVIEW

T01-P03 Bioconversion of Single-Carbon Effluents into Biofuels and Biofuel Precursors

The aim of this project is to develop a platform technology for the bioconversion of C1 compounds resulting from forestry activities (fermentation, thermal processing, anaerobic digestion) into biofuels (alcohols, lipids) and biofuel precursors (e.g. isoprenoids). This platform will be integrated in the greater context of biomass conversion by, for example, using by-product streams from other bioconversion activities (e.g. anaerobic digestion and pyrolysis) as feedstock.

https://logosconcarne.com/2016/02/23/frog-in-hot-water/
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