Production of Diesel and Jet Fuel Intermediates Using Hybrid Gasification-Syngas Fermentation

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OBJECTIVE
To investigate the abilities of a monoculture of Alkalibaculum bacchi CP15 and a mixed culture made of CP15 and Clostridium propionicum to produce n-butanol and n-hexanol from syngas and to convert carboxylic acids into alcohols.

INTRODUCTION

- Hybrid gasification-syngas fermentation conversion process provides a flexible platform for production of biofuels and chemicals from biomass with potentially higher yields compared to only thermochemical or biochemical conversion.
- The hybrid conversion process has feedstock flexibility and utilizes all components of biomass including lignin in syngas.
- Syngas fermentation operates near ambient pressure and temperature.
- Biological production of higher alcohol biofuels, such as n-butanol and n-hexanol, from syngas components (i.e., CO, CO2 and H2) is a promising approach for the commercialization of renewable, carbon-neutral liquid transportation fuels.
- n-butanol and n-hexanol have higher energy densities than ethanol and are compatible with current fuel infrastructure.
- Butanol and hexanol are considered intermediates for the production of diesel and jet fuels.
- An analysis of 16S rRNA genes of continuous fermentation culture revealed that the bioreactor contained a mixed culture consisting of 56% strain CP15 and 34% Clostridium propionicum [1].
- Findings presented a new opportunity for production of intermediates of jet and diesel fuel from syngas using mixed culture.

MATERIALS AND METHODS

- Fermentations were performed in triplicate in 250 mL bottles with 100 mL medium at 37°C and pH 7.5. Fermentation bottles were pressurized to 239 kPa every 24 h with syngas containing 40% CO, 30% CO2, and 30% H2.
- About 1.5 g/L of propionic acid, butyric acid, hexanoic acid and lactic acid were added to the medium at the beginning of fermentation to examine their conversion to the respective alcohols.
- Cell concentration was measured using a spectrophotometer at 660 nm. Solvent concentrations and gas phase compositions were determined by GC equipped with FID and TCD detectors, respectively.

RESULTS

- Cell growth and product profiles using monoculture and mixed culture [2]
- Conversion of carboxylic acids to alcohols observed in both CP15 monoculture and mixed culture.
- Mixed culture was 50% more efficient in converting organic acids to their respective alcohols, such as n-butanol and n-hexanol, than CP15 monoculture.

CONCLUSIONS

- Mixed culture was 50% more efficient in converting organic acids to their respective alcohols, such as n-butanol and n-hexanol, than CP15 monoculture.
- The synergy of mixed culture resulted in over 60% more alcohol production than CP15 monoculture.

REFERENCES


ACKNOWLEDGEMENT
This research was supported by USDA-NIFA, Oklahoma Agricultural Experiment Station, Oklahoma Bioenergy Center, National Science Foundation EPSCoR program under Grant EPS-0814391.