Commodity Chemicals Production from C1 Gases in Moorella thermoacetica
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Introduction

Microbial chassis organisms are crucial for chemicals bioproduction. Indeed, modern genetic tools allow for the modification or insertion of genes in these organisms to produce desired target compounds. Acetogenic bacteria, or acetogens, are promising hosts as they convert CO and CO₂ into acetate and other products during gas fermentation.

The acetogen Moorella thermoacetica is interesting for industrial gas fermentation as its thermophilic requirements allow higher operating temperatures. Thus, this project focuses on creating synthetic pathways and implementing them in M. thermoacetica to produce platform chemicals.

Pathway design

To produce non-native compounds, synthetic metabolic pathways have been designed using the computational tools From Metabolite to Metabolite¹ and Metabolic Route Explorer². The chosen targets are widespread industrial chemicals, such as ethylene glycol or 1,2-propanediol. After pathway design, different pruning criteria, including gene availability or pathway length, are applied to select the best candidate pathways.

Further genome-scale analysis excludes inappropriate pathways. For example, the constraint-based COBRA³ toolbox is used to assess pathway feasibility in the genome-scale model of M. thermoacetica.

Pathway Implementation

Once feasible pathways have been selected, implementation in M. thermoacetica is attempted to produce the target compounds. However, this first requires the development and improvement of genetic tools for this organism. Indeed, although some tools have been created⁴,⁵, they are still limited and prevent metabolic engineering of this organism. While developing such genetic tools, implementation is currently being attempted for a candidate pathway for ethylene glycol production.

Future work

Current work focuses on developing the genetic tools necessary for metabolic engineering in M. thermoacetica. If ethylene glycol can be produced from the chosen pathway, further downstream engineering, such as gene deletions, will be performed to increase yield. Pathways for other target products will also be introduced in M. thermoacetica to further demonstrate its importance as a chassis organism. This work will also strengthen our knowledge on M. thermoacetica and its metabolism.

REFERENCE

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