

# Production of 3-hydroxypropionic via malonyl-CoA pathway from acetate

Mugesh Sankaranarayanan, Yeonhee Kim and Sunhoon Park\*

School of Energy and Chemical Engineering UNIST-Gil 50, Eonyang-eup, Ulsju-gun, Ulsan, Republic of Korea- 44919 \*E-mail: parksh@unist.ac.kr.

## Microbial production of 3-HP from acetate

### 1. Establishment of 3-HP producing strain from acetate

- Selection of host strains
- Identification of pathway for 3-HP biosynthesis

### 2. Optimization of the production strain

- Development of biosynthetic pathway
- Gene expression and enzyme activity

### 3. Optimization of production conditions and processes

- Commercialization of strain
- Development of process and production technology

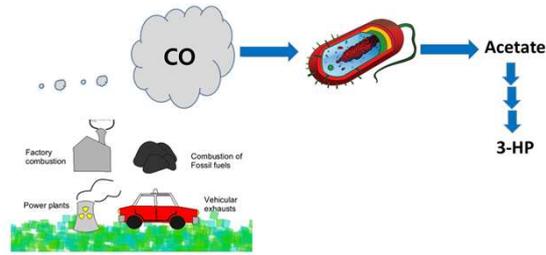


Fig 1: Sources of emission of carbon monoxide (CO) and microbial production of 3-HP from CO

## Development of biosynthetic pathway

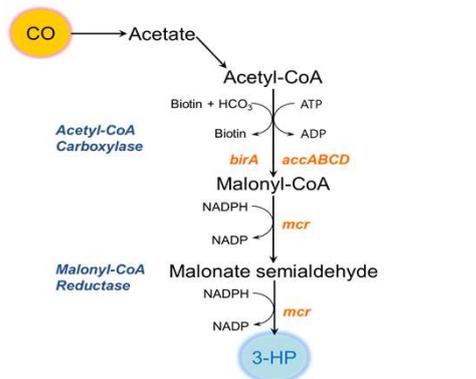


Fig 2: Biosynthetic pathway for the production of 3-HP from CO

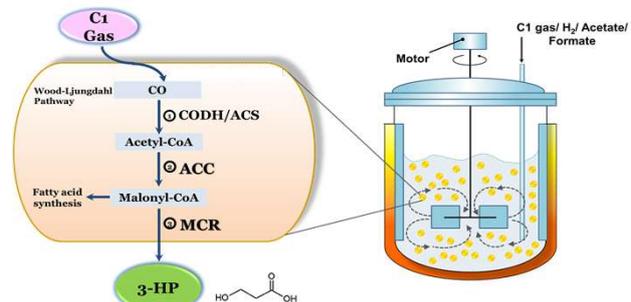


Fig 3: Schematic representation of 3-HP production from C1 gas

➤ Source of *mcr* gene : *Chloroflexus aurantiacus*

## Development of 3-HP production strain

### Dissection of *mcr*

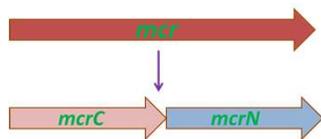


Fig 4: Dissection of malonyl-CoA reductase (*mcr*)

- The functionally distinct C-terminal and N-terminal regions of Malonyl-CoA reductase (*mcr*) were dissected into *mcrC* and *mcrN*.
- *mcrC* is involved in the conversion of malonyl-CoA to malonate semialdehyde.
- *mcrN* is involved in the production of 3-HP from malonate semialdehyde.

### Expression system for 3-HP production

From acetate using *E. coli*

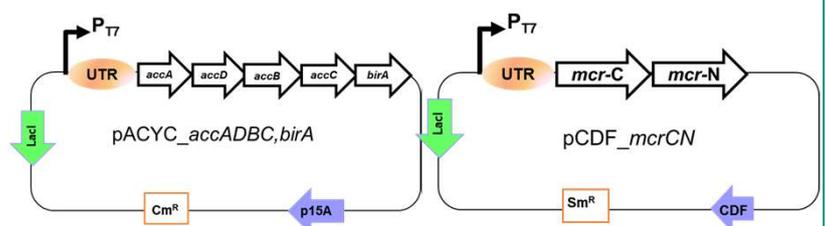


Fig 5: A) Overexpression of acetyl-CoA carboxylase in pACYCDuet vector, B) Overexpression of malonyl-CoA reductase in pCDFDuet vector

## Results and Discussion

### Production of 3-HP from acetate

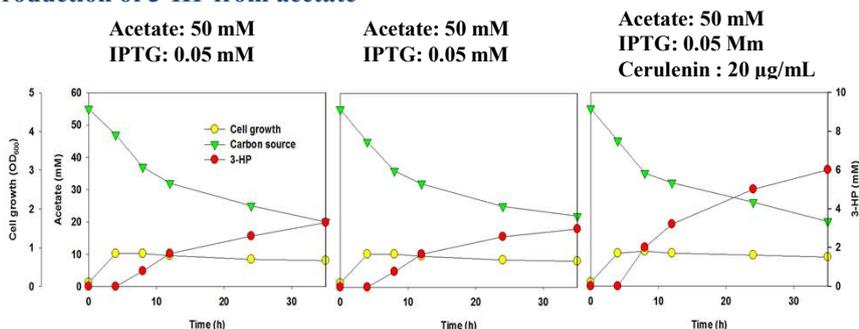


Fig 7: Time course profile of cell growth (yellow circle), residual carbon source (green triangle) and 3-HP production (red circle) from acetate using recombinant *E. coli*

- The production of 3-HP from acetate using recombinant *E. coli* strain was successfully proved.
- The different levels of inducer concentration did not show much variation in the 3-HP production.
- The addition of cerulenin (by blocking fatty acid biosynthesis) enhanced the production of 3-HP while using acetate as the sole carbon source.

### Effect of overexpression of formate dehydrogenase (*fdh*) on 3-HP production from acetate

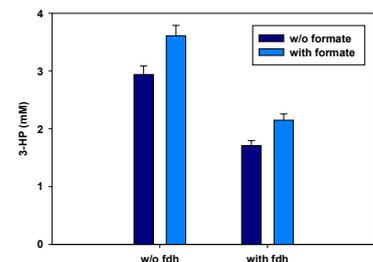


Fig 8: Effect of overexpression of formate dehydrogenase (*fdh*) on 3-HP production from acetate

- The overexpression of *fdh* did not improve 3-HP production; rather, it exhibited decreased 3-HP production due to an additional gene expression.

### ACKNOWLEDGEMENT

This work was supported by the C1 gas refinery center (Funding number: 2017M3D3A1A01036927). The authors are also grateful for the financial assistance provided by Ulsan National Institute of Science and Technology.