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

Mugesh Sankaranarayanan, Yeonhee Kim and Sunghoon Park*
School of Energy and Chemical Engineering UNIST-Gil 50, Eonyang-eup, Ulju-gun, Ulsan, Republic of Korea- 44919 *E-mail: parksh@unist.ac.kr.

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.

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

Development of biosynthetic pathway

Dissection of mcr

- Source of mcr gene: Chloroflexus aurantiacus
- 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

Results and Discussion

Production of 3-HP from acetate

- Acetate: 50 mM
  - IPTG: 0.05 mM
  - Cerulenin : 20 μg/mL

- Acetate: 50 mM
  - IPTG: 0.05 mM

- Acetate: 50 mM
  - IPTG: 0.05 Mm

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 so much variation in the 3-HP production.
- The addition cerulenin (by blocking fatty acid biosynthesis) enhanced the production of 3-HP while using acetate as sole carbon source.

Effect of overexpression of formate dehydrogenase (fdh)

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

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