Engineered bacterium produces 1,3-diaminopropane, an important industrial chemical

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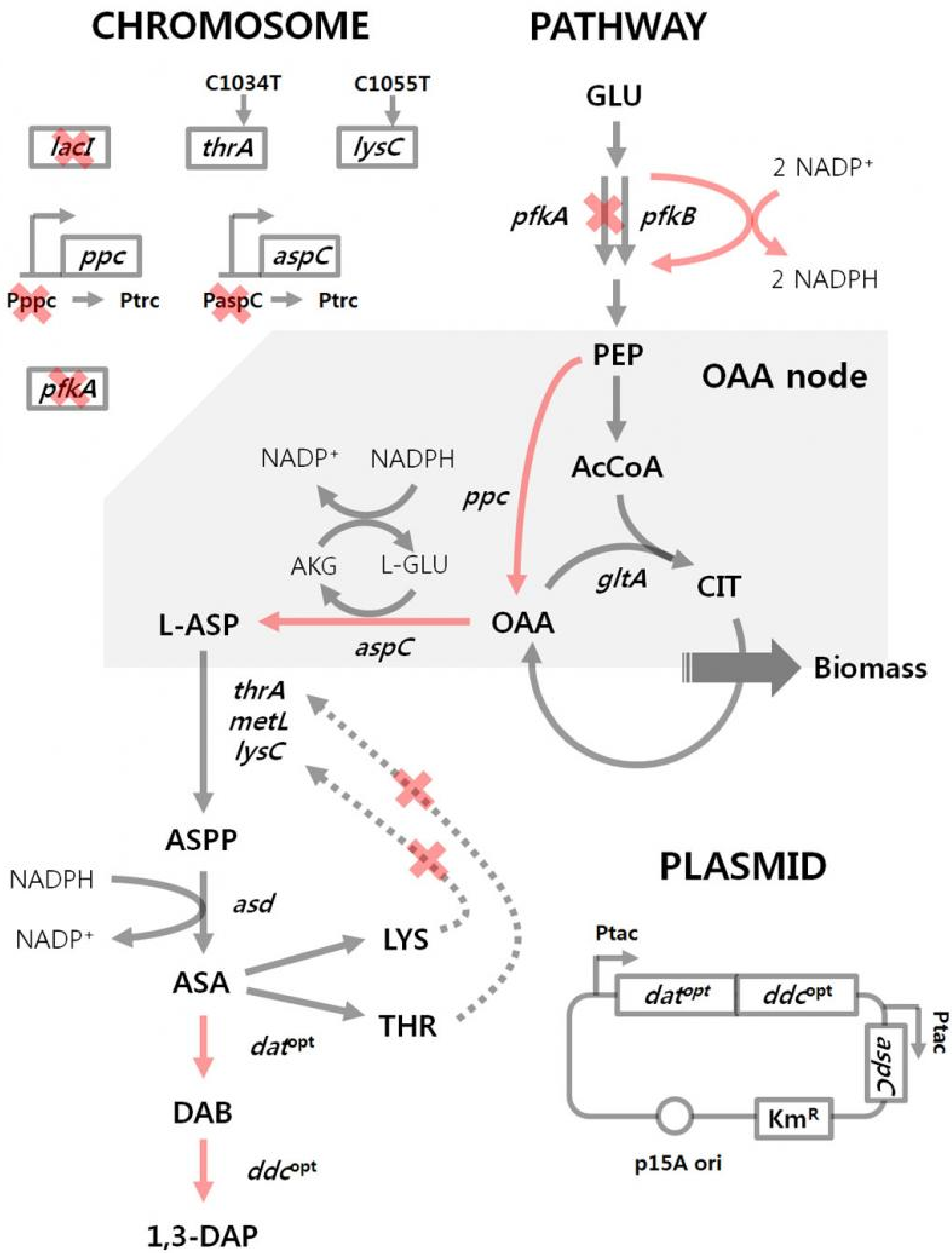
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lysC
ppc
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Ptrc
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Ptrc
pfkA
GLU
pfkA
pfkB
2 NADP+
2 NADPH
PEP
OAA node
AcCoA
NADP+
NADPH
ppc
AKG
L-GLU
gltA
CIT
L-ASP
OAA
aspC
Biomass
thrA
metL
lysC
ASPP
NADPH
NADP+
asd
LYS
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THR
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ddcopt
1,3-DAP
PLASMID
Ptac
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Metabolic engineering strategies for 1,3-diaminopropane production using C4 pathway. Credit: KAIST

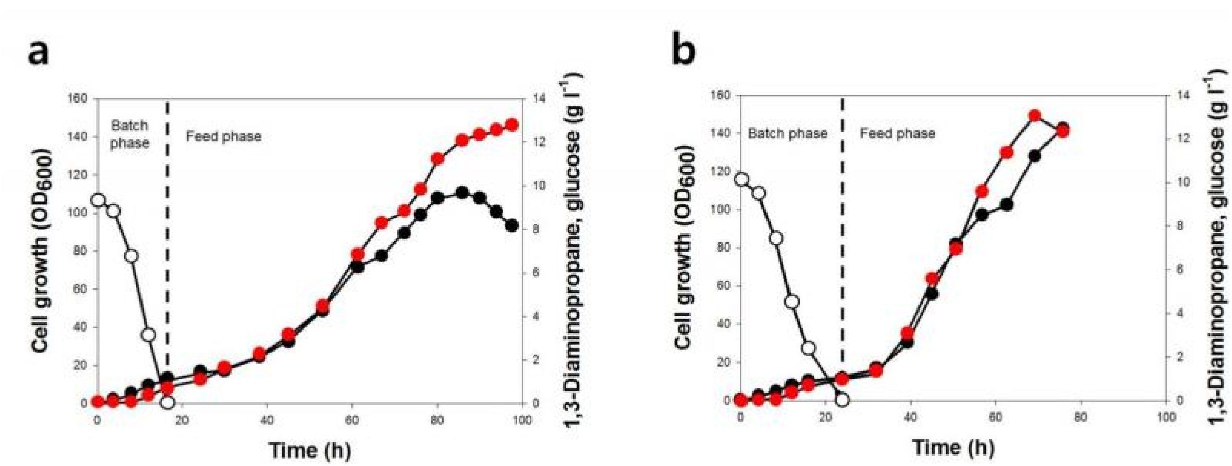
A Korean research team led by Distinguished Professor Sang Yup Lee of the Department of Chemical and Biomolecular Engineering at the Korea Advanced Institute of Science and Technology (KAIST) reported, for the first time, the production of 1,3-diaminopropane via fermentation of an engineered bacterium.

1,3-Diaminopropane is a three carbon diamine, which has a wide range of industrial applications including epoxy resin and cross-linking agents, as well as precursors for pharmaceuticals, agrochemicals, and organic chemicals. It can also be polymerized with dicarboxylic acids to make polyamides (nylons) for use as engineering plastics, medical materials, and adhesives. Traditionally, 1,3-diaminopropane is derived from petroleum-based processes. In effort to address critical problems such as the depletion of petroleum and environmental issues inherent to the petroleum-based processes, the research team has developed an Escherichia coli (*E. coli*) strain capable of producing 1,3-diaminopropane. Using this technology, 1,3-diaminopropane can now be produced from renewable biomass instead of petroleum.

E. coli as found in nature is unable to produce 1,3-diaminopropane. Metabolic engineering, a technology to transform microorganisms into highly efficient microbial cell factories capable of producing chemical compounds of interest, was utilized to engineer the *E. coli* strain. First, naturally existing metabolic pathways for the biosynthesis of 1,3-diaminopropane were introduced into a virtual cell in silico to determine the most efficient metabolic pathway for the 1,3-diaminopropane production. The metabolic pathway selected was then introduced into an *E. coli* strain and successfully produced

1,3-diaminopropane for the first time in the world.

The research team applied metabolic engineering additionally, and the production titer of 1,3-diaminopropane increased about 21 fold. The Fed-batch fermentation of the engineered *E. coli* strain produced 13 grams per liter of 1,3-diaminoproapne. With this technology, 1,3-diaminopropane can be produced using renewable biomass, and it will be the starting point for replacing the current petroleum-based processes with bio-based processes.



Fed-batch fermentation profiles of two final engineered *E. coli* strains. Credit: KAIST

Professor Lee said, "Our study suggested a possibility to produce 1,3-diaminopropane based on biorefinery. Further study will be done to increase the titer and productivity of 1,3-diaminopropane."

More information: Chae, T.U. et al. "Metabolic engineering of Escherichia coli for the production of 1,3-diaminopropane, a three carbon diamine," *Scientific Reports*: www.nature.com/articles/srep13040

Provided by The Korea Advanced Institute of Science and Technology (KAIST)