P-12

アーキア膜脂質によるバクテリア膜脂質の置換に基づく大腸菌の細胞膜エンジニアリング

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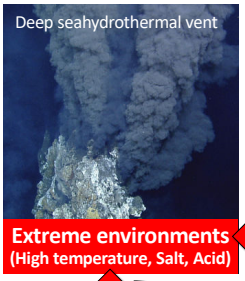
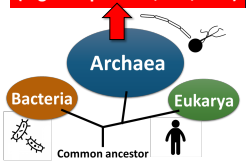
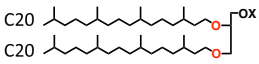
Introduction



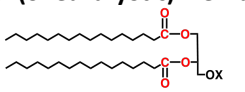
Extreme environments
(High temperature, Salt, Acid)



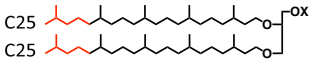
Archaeal membrane lipid



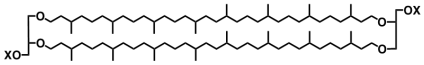
Bacterial (or eukaryotic) membrane lipid



Hyperthermophilic archaeal membrane lipids



C25 archaeal membrane lipid
(*Aeopyrum pernix*)

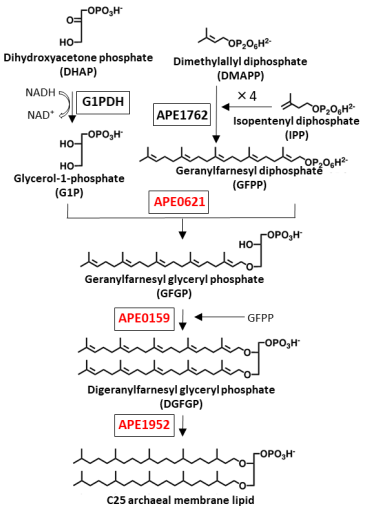


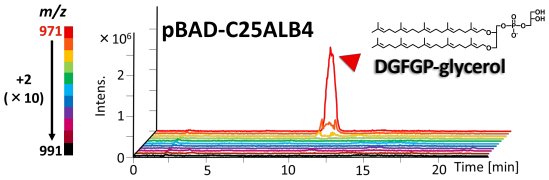
C40 archaeal membrane lipid
(many archaea)

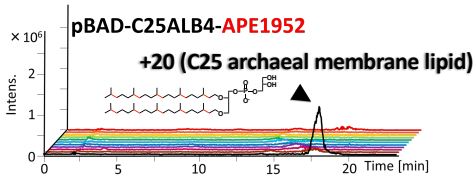
Adaptation mechanism to extreme environments?

Aim of this research

Engineering the lipid membrane of *Escherichia coli* by the production of hyperthermophilic archaeal membrane lipids to make it more rigid and less permeable, which might be beneficial especially when *E. coli* is used for the bio-production of hydrophobic compounds.





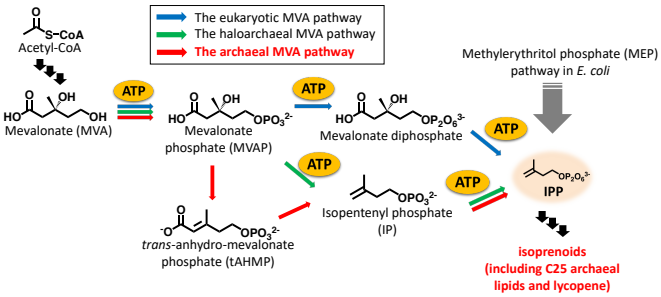


➢ C25 archaeal membrane lipids could be produced in *E. coli*; however, the amount of these lipids was too small to investigate the effects of the production of C25 archaeal membrane lipids on *E. coli* cells.

[Ref] R. Yoshida et al. *Biochem. Biophys. Res. Commun.* (2018)

Results

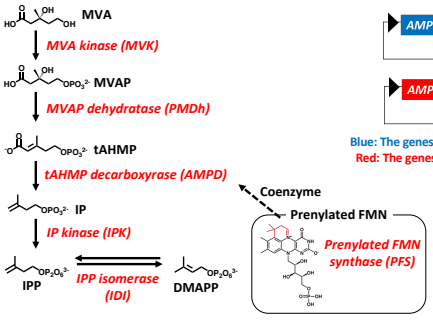
● Discovery of the archaeal MVA pathway

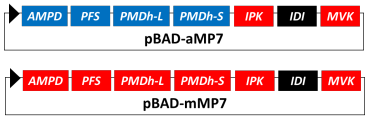


➢ A modified MVA pathway, which consumes less ATP than other known MVA pathways do, was discovered from *A. pernix* and designated as the archaeal MVA pathway.

[Ref] H. Hayakawa et al. *PNAS* (2018)

● Reconstruction of the archaeal MVA pathway in *E. coli*



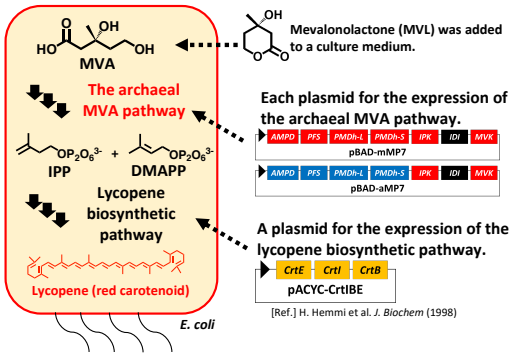


Blue: The genes derived from a hyperthermophilic archaeon *Aeropyrum pernix*.
Red: The genes derived from a meshophilic archaeon *Methanosarcina mazei*.
Black: The gene derived from *E. coli*.

Construction of artificial operons

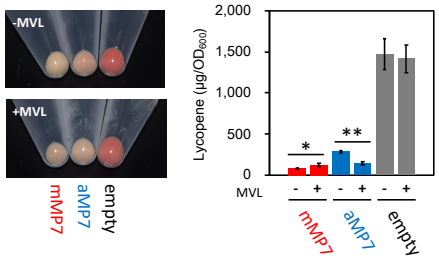
➢ Plasmids harboring the genes of the lower part of the archaeal MVA pathway were constructed.

● Measurement of lycopene productivity to check if the archaeal MVA pathway can function in *E. coli* cells

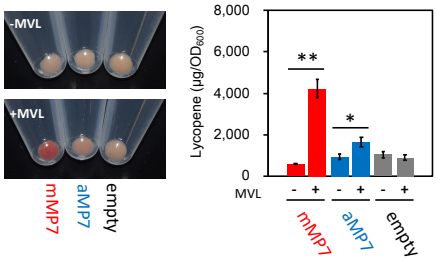


[Ref.] H. Hemmi et al. *J. Biochem* (1998)

Aerobic cultivation



Semi-anaerobic cultivation



➢ Introduction of the archaeal MVA pathway enhanced isoprenoid productivity of *E. coli* under semi-anaerobic conditions.

[Ref] R. Yoshida et al. *Appl. Environ. Microbiol.* (2020)

Perspective

➢ Enhancement of the production of C25 archaeal membrane lipids by the introduction of the archaeal MVA pathway.
➢ Assessment of the properties of *E. coli* cell membrane including C25 archaeal membrane lipids.