Understanding and Improving Conversion of Lignin-Derived Aromatic Compounds in Novosphingobium aromaticivorans

Background

- Bacteria can convert lignin-derived aromatic compounds into value-added products.
- However, assimilation of aromatic dimers is generally slow, and the relevant pathways are poorly characterized

Approach

- We used experimental evolution to select for mutants of *N. aromaticivorans* F199 that grew more rapidly with a model lignin-derived aromatic dimer, guaiacylglycerol-β-guaiacyl ether (GGE).
- We then characterized these mutant strains to identify the causal mutations and understand the biochemical factors that had previously limited conversion of lignin-derived aromatic compounds.

Results

- We identified three mutant bacterial strains that rapidly catabolized GGE and shared several parallel regulatory mutations.
- One of the regulatory mutations increased expression of an uncharacterized enzyme, which we named HpvY.
- We showed that HpvY is required for catabolism of a GGE-derived aromatic monomer, β-HPV and characterized the enzyme activity in vitro.

Significance

- We demonstrated that lignin-derived aromatic dimers can be rapidly assimilated, and that the assimilation rate can be limited by regulation rather than by inherent biochemical bottlenecks.
- Our analysis of HpvY expands the known biochemical pathways for aromatic catabolism in a potential host for lignin valorization, enabling future metabolic engineering in *Novosphingobium aromaticivorans*.

Allemann MN et al. Appl Env Microbiol (2025) doi.org/10.1128/aem.02081-24

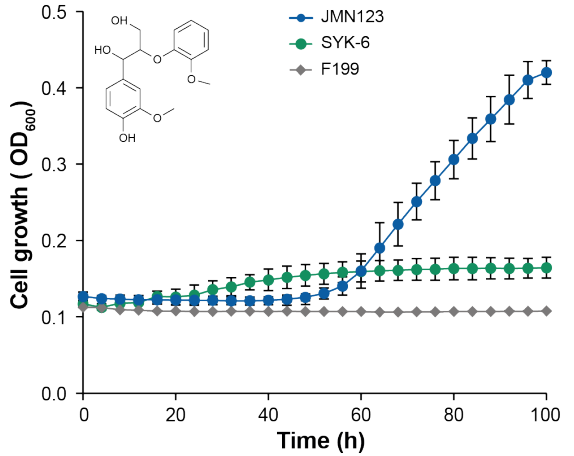

Figure 1: Growth of wild-type (grey/green) and evolved (blue) strains with a model lignin-derived aromatic dimer (GGE).

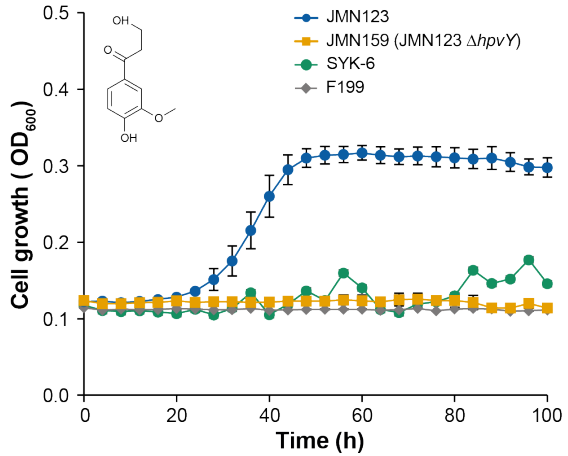

Figure 2: Growth of evolved (blue) and *hpvY* knockout (orange) strains with the GGE-derived monomer β-HPV.