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**Biological funneling of aromatics from chemically depolymerized lignin produces a desirable chemical product**

Engineered *Novosphingobium aromaticivorans* funnels heterogeneous mixtures of lignin depolymerization products to a potential polyester precursor

**The Science**

Lignin is an abundant but tough polymer found in plant biomass. Breaking down lignin, whether through biological or chemical means, invariably produces heterogenous mixtures of low molecular weight aromatic (ring-containing) compounds. Microbes that can metabolize lignin-derived aromatics have evolved pathways that funnel these heterogeneous mixtures into a few common intermediates, which simplifies further processing. Scientists at the Great Lakes Bioenergy Research Center engineered *Novosphingobium aromaticivorans* DSM12444 to convert multiple lignin-derived aromatics into a single chemical called 2-pyrone-4,6-dicarboxylic acid (PDC), a potential precursor for making polyester, epoxy adhesives, and other bioplastics.

**The Impact**

This work represents a valuable advance in using bacteria to funnel mixtures of aromatic compounds into defined single commodities. It also shows that *N. aromaticivorans* could be an ideal microbial platform for valorization of lignin and other plant-derived aromatics. Ultimately, the information and strategies developed here and in future optimization of PDC production by *N. aromaticivorans* may help engineer this and other microbes to produce a wide range of additional valuable compounds from lignin.

**Summary**

Despite recent advances in plant biomass deconstruction and lignin depolymerization strategies, the heterogeneity of resulting product mixtures presents a major challenge for conversion into commodity chemicals. In this work, Great Lakes Bioenergy Research Center scientists created a defined set of mutations in the central aromatic catabolic pathways of *N. aromaticivorans* DSM12444*.* This engineered strain was able to simultaneously convert the three major types of plant-derived aromatic compounds (those containing syringyl (S), guaiacyl (G), and *p*-hydroxyphenyl (H) aromatic units) into PDC.

In batch cultures containing defined media, the engineered strain converted several of these depolymerization products, including S-diketone and G-diketone (non-natural compounds specifically produced by chemical depolymerization), into PDC with yields ranging from 22% to 100%. In batch cultures containing a heterogeneous mixture of aromatic monomers derived from chemical depolymerization of poplar lignin, 59% of the measured aromatic compounds were converted to PDC. Overall, the results show that *N. aromaticivorans* has ideal characteristics for its use as a microbial platform for funneling heterogeneous mixtures of lignin depolymerization products into PDC or other commodity chemicals.

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**Publications**

Perez, J. M. *et al.* “Funneling aromatic products of chemically depolymerized lignin into 2-pyrone-4-6-dicarboxylic acid with *Novosphingobium aromaticivorans*.” *Green Chemistry* (2019) [DOI: 10.1039/C8GC03504K].

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