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**Discovering enzymes responsible for biodegradation of lignin to release high-value monomeric aromatic compounds**

Releasing compounds for use in making high-value chemicals.

**The Science**

Many bacteria contain enzymes with the potential to convert renewable carbon sources into substitutes for compounds derived from petroleum. For example, the β-etherase pathway present in sphingomonad bacteria could cleave the abundant β-ether bonds in plant lignin, releasing a bio-based source of aromatic compounds for the chemical industry. In this study, GLBRC researchers demonstrated biodegradation of lignin polymers using a minimal set of β-etherase pathway enzymes.

**The Impact**

Plant lignin contains aromatic compounds that, when released, could be used to make valuable commodities for the biofuel, chemical, cosmetic, food, and pharmaceutical industries, and replace petroleum-based fuels and chemicals with bio-renewable materials. This study demonstrates biodegradation of lignin polymers using a minimal set of bacterial β-etherase pathway enzymes that results in cleavage of β-ether bonds in plant lignin, thereby releasing aromatic compounds from lignin for potential use in making these high-value chemicals.

**Summary**

New sustainable technologies are needed to derive valuable compounds from renewable resources. Lignin, an abundant polymer in terrestrial plants comprised predominantly of guaiacyl and syringyl monoaromatic phenylpropanoid units, is a potential natural source of aromatic compounds. In addition, the plant secondary metabolite tricin is a recently discovered and moderately abundant flavonoid in grasses. The most prevalent interunit linkage between guaiacyl, syringyl, and tricin units is the β-ether linkage. Previous studies have shown that bacterial β-etherase pathway enzymes catalyze glutathione-dependent cleavage of β-ether bonds in dimeric β-ether lignin model compounds. To date, however, it remains unclear whether the known β-etherase enzymes are active on lignin polymers. In this study, GLBRC researchers report on enzymes that catalyze β-ether cleavage from bona fide lignin, under conditions that recycle the cosubstrates NAD+ and glutathione. Guaiacyl, syringyl, and tricin derivatives were identified as reaction products when different model compounds or lignin fractions were used as substrates. These results demonstrate an *in vitro* enzymatic system that can recycle cosubstrates while releasing aromatic monomers from model compounds as well as natural and engineered lignin oligomers. These findings can improve the ability to produce valuable aromatic compounds from a renewable resource like lignin.

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**Publications**

Gall, D. L. *et al.* “*In vitro* enzymatic depolymerization of lignin with release of syringyl, guaiacyl, and tricin units.” *Applied and Environmental Microbiology* 84, e02076-17 (2018) [DOI: 10.1128/AEM.02076-17].

**Related Links**

<http://aem.asm.org/content/84/3/e02076-17.full?sid=a8ed9d24-9ea2-4294-8dce-e03edc8ad474>

**PM Recommendation for SC Web Publication**