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**Fungus-cultivating termites exhibit strikingly rapid and efficient degradation of woody biomass**

Lignocellulose pretreatment in a fungus-cultivating termite symbiotic system*.*

**The Science**

Depolymerizing lignin, the complex phenolic polymer fortifying plant cell walls, is challenging, making lignin a major barrier to gaining access to stored energy in lignocellulosic materials. Here we reveal unprecedentedly rapid lignin depolymerization and degradation in an ancient fungus-cultivating termite system; we combine laboratory-feeding experiments with step-wise structural and chemical analyses performed while the woody material is digested in this symbiotic system.

**The Impact**

In the fungus-cultivating termite symbiotic system, lignin depolymerization takes place during the rapid passage through the pH-neutral gut of young worker termites. Striking in its speed and efficiency, the process destroys the traditionally-considered most recalcitrant C–C-bonded lignin structural units, thereby facilitating efficient degradation of the polysaccharide substrate by processes subsequently occurring via the fungus-comb microbiome. Thus, natural systems for lignin degradation/pretreatment are far beyond what was previously recognized and are potential sources of novel ligninolytic agents, enabling more efficient plant cell wall utilization.

**Summary**

Depolymerizing lignin, the complex phenolic polymer fortifying plant cell walls, is an essential but most challenging starting point for the lignocellulosics industries. The variety of ether and carbon-carbon interunit linkages produced via radical coupling during lignification limit chemical and biological depolymerization efficiency. In an ancient fungus-cultivating termite system, we reveal unprecedentedly rapid lignin depolymerization and degradation by combining laboratory feeding experiments, lignocellulosic compositional measurements, electron microscopy, 2D-NMR, and thermochemolysis. In a gut transit time of under 3.5 hours, in young worker termites, poplar lignin sidechains are extensively cleaved and the polymer is significantly depleted, leaving a residue almost completely devoid of various condensed units that are traditionally recognized to be the most recalcitrant. Subsequently, the fungus-comb microbiome preferentially utilizes xylose and cleaves polysaccharides, thus facilitating final utilization of easily digestible oligosaccharides by old worker termites. This complementary symbiotic pretreatment process in the fungus-growing termite symbiosis reveals a previously unappreciated natural system for efficient lignocellulose degradation.

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**Publications**

Li, H. *et al.* “Lignocellulosic pretreatment in a fungus-cultivating termite**.”** *Proc. Natl. Acad. Sci. USA* (2017) [DOI: 10.1073/pnas.1618360114].

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<http://www.pnas.org/content/early/2017/04/18/1618360114.abstract>

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