How tiny enzymes reign supreme in worldwide carbon recycling

December 4 2019, by Mark Derewicz

White rot fungi, Duke Forest, North Carolina Credit: NA

The recycling of most of the carbon in nature depends on the breakdown of two polymers in woody matter, notably cellulose and lignin. In a paper just published in the journal *Biochemistry*, Richard Wolfenden, Ph.D., and colleague Charles Lewis, Ph.D., both in the UNC Department of Biochemistry and Biophysics, show the extent to which enzymes from woodland fungi accelerate the breakdown of lignin, a complex polymer held together entirely by ether linkages.

After a tree falls in the forest and the chain saw has done its work, clusters of white-rot fungi appear near the cut surfaces. "Etherases" from these lowly fungi use the antioxidant glutathione to clip ether linkages in 23 milliseconds. Lewis and Wolfenden show that without these enzymes, the half-life for the needed hydrolysis of the ether linkages in lignin in water would be about 100 billion years, exceeding the age of the universe by a long shot.

So it turns out that these familiar organisms catalyze what is generally considered to be the rate-determining step in the global carbon cycle, using enzymes that are found to achieve the largest rate enhancement known for any of the thousands of enzymes that exist.

Without these little enzymes, we'd be in a world of hurt.

More information: Charles A. Lewis et al, Ether Hydrolysis, Ether Thiolysis, and the Catalytic Power of Etherases in the Disassembly of Lignin, *Biochemistry* (2019). DOI: 10.1021/acs.biochem.9b00698

Provided by University of North Carolina Health Care