Biomass heating could get a 'green' boost with the help of fungi

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In colder weather, people have long been warming up around campfires and woodstoves. Lately, this idea of burning wood or other biomass for heat has surged in popularity as an alternative to using fossil fuels. Now, in the journal *ACS Sustainable Chemistry & Engineering*, scientists report a step toward a "greener" way to generate heat with biomass. Rather than burning it, which releases pollutants, they let fungi break it down to release heat.

The benefit of biomass, which consists of plant material and animal waste, is that there is no shortage. It is produced continuously in enormous quantities as a waste product from paper and agricultural industries. But burning it emits fine particles and volatile organic compounds, or VOCs, linked to health and environmental problems. So scientists have been trying to figure out how to use biomass with minimal emissions. One approach involves adding microorganisms that can degrade the materials. In this process, heat is released without giving off fine particles or VOCs. So far, most investigations into this method have involved room-temperature conditions. But for sustained use, these reactions would need to take place at temperatures above ambient conditions as heat is produced. Leire Caizán Juanarena and colleagues wanted to warm things up to see how much heat they could coax out of the process.

The researchers incubated two fungi species that do well in hot climates—lignin-degrading Phanerochaete chrysosporium and cellulose-degrading Chaetomium thermophilum—with blocks of birch wood,

either sterile or with its natural biota. C. thermophilum produced the most heat (0.63 Watts per kilogram) when degrading wood with its usual microbial inhabitants. To generate enough heat for an average home in the Netherlands, for example, the researchers say they need to determine optimal nutrient, moisture and temperature conditions, as well as other parameters, to increase power production to 6 W/kg.

More information: Leire Caizan Juanarena et al. Wood degradation by thermotolerant and thermophilic fungi for sustainable heat production, *ACS Sustainable Chemistry & Engineering* (2016). DOI: 10.1021/acssuschemeng.6b00914

Abstract

The use of renewable biomass for production of heat and electricity plays an important role in the circular economy. Degradation of wood biomass to produce heat is a clean and novel process proposed as an alternative to wood burning, and could be used for various heating applications. So far, wood degradation has mostly been studied at ambient temperatures. However, the process needs to occur at elevated temperatures (40-55 °C) to produce useable heat. Our objective was to study wood degradation at elevated temperatures for its potential application on heat production. Two (a thermotolerant and a thermophilic) fungi with different degradation strategies were chosen: lignin-degrading Phanerochaete chrysosporium and cellulose-degrading Chaetomium thermophilum. Each fungus was inoculated on non-sterile and sterile birch woodblocks to respectively study their wood degradation activity with and without natural biota (i.e., microorganisms naturally present in wood). The highest wood decay rates were found with C. thermophilum in presence of natural biota, followed by P. chrysosporium under sterile conditions. The estimated theoretical value of heat production with C. thermophilum under non-sterile conditions was 0.6 W kg-1 wood. In conclusion, C. thermophilum seems a promising fungus to degrade wood together with natural biota, as

sterilization of wood is not feasible in practice. Further testing on larger scale is needed to implement the obtained results and validate the potential of biological wood degradation for heat production.

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