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Unveiling the hidden side of brown-rot wood decay in anoxia

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PURPOSE OF THE ABSTRACT

Global forests are a large and persistent carbon sink [1] with fungal brown-rot wood decay playing a key role in the carbon cycle by participating in organic matter turnover [2]. For decades, this destructive decaying process was claimed to mainly rely on Fenton chemistry initiating the efficient degradation of plant cell wall polysaccharides [3]. However, the importance of O2 in this microbial degradation process has been overlooked. In this study, we designed fungal fermentation to study the effect and influence of O2 on this wood-decaying process. We developed a methodological set-up that enabled us to follow fungal growth, enzyme secretion, and biomass degradation using the brown rot fungi model organisms. Using O2 gradients and defined O2 concentrations (0 – 20.9%), we uncovered an anoxic lifestyle of Fomitopsis pinicola, which was able to grow on softwood in the absence of O2. Applying complementary biochemical techniques and deep proteomic analysis, we confirmed the presence of Fenton markers in the O2 growth condition and revealed its mechanism of wood degradation in the absence of O2. Strikingly, anoxic conditions induced the secretion of a wide range of cellulases and hemicellulases targeting both glucuronoxylan and galactomannan. In conclusion, we unveiled fungal wood decay under anoxic conditions highlighting, in a brown-rot fungus, the importance of carbohydrate-active enzymes for polysaccharide degradation. These results challenge the established dogma of Fenton chemistry-dependent brown-rot decay. We are convinced that this work will open new opportunities for industrial biocatalysis and anaerobic biotransformation applications.

FIGURES

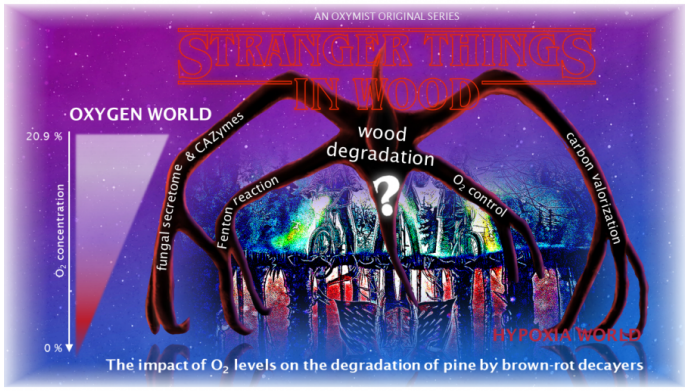

FIGURE 1

The impact of O2 levels on the degradation of pine by brown-rot decayers

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FIGURE 2

KEYWORDS

brown-rot wood decay | Fenton chemistry | anoxic fermentation | carbohydrate-active enzymes

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