Patterns of lignin degradation and oxidative enzyme activities of dead wood in different decay stages

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Main design : We investigate dead wood logs of different decay stages in the three German Biodiversity Exploratories (Schorfheid-Chorin, Hainich-Dün, Schwäbische-Alb):
- **10 Plots per exploratory** with different forest management intensity
- **200 dead wood logs** of beech (*Fagus sylvatica*), spruce (*Picea abies*) and pine (*Pinus sylvestris*);
- **3 to 7 wood samples** per log were taken

Funwood

Fungi are the major wood decomposers

substantial biological disintegration and recycling of woody lignocelluloses, i.e. of the whole plant cell-wall complex, is seemingly a unique feature of filamentous fungi

dead wood is decayed notably by basidiomycetous fungi (white- and brown-rotters) and a few ascomycetous soft-rot fungi

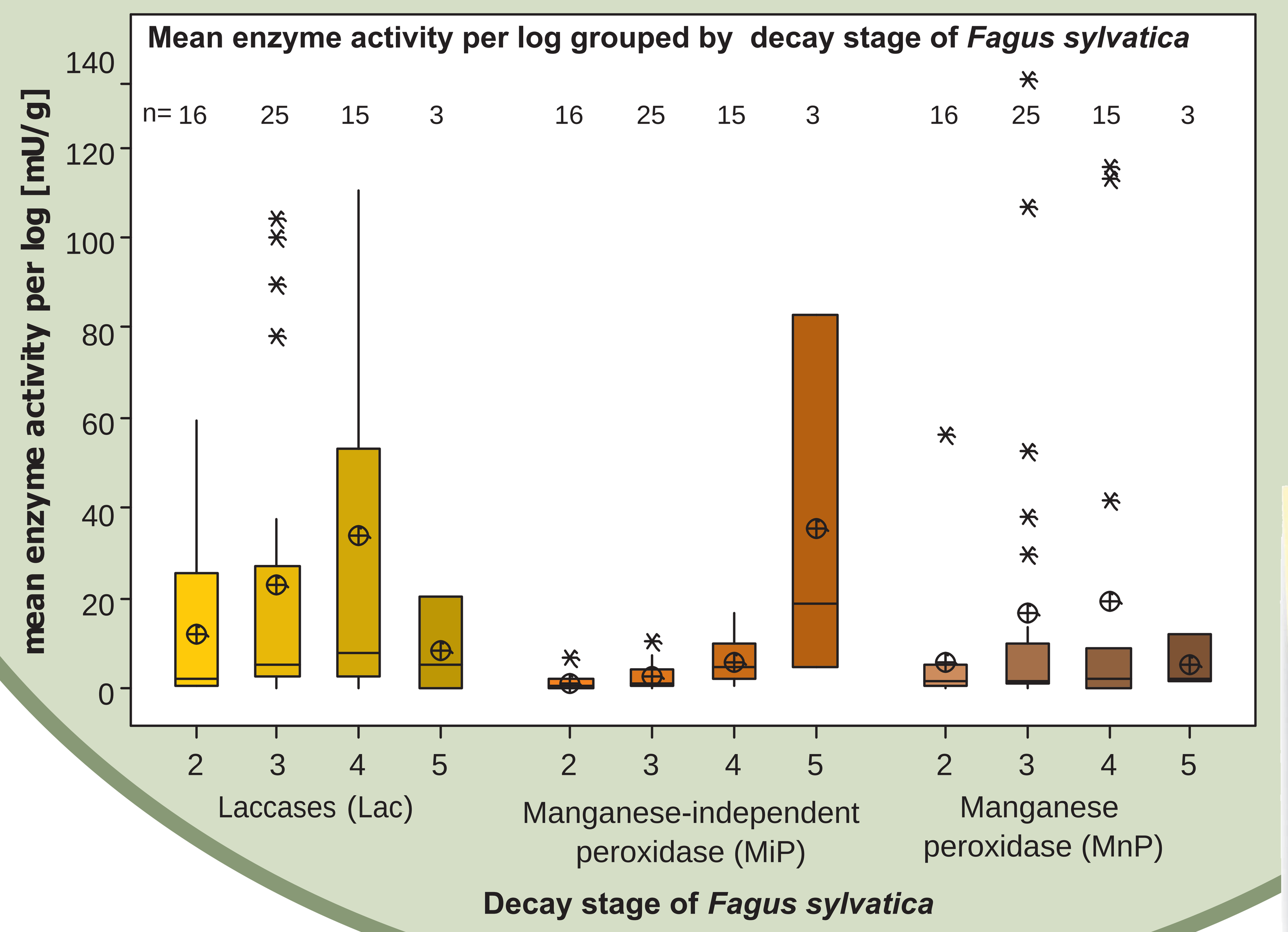
secreting different oxidative and hydrolytic enyzmes to accomplish lignocellulose degradation

Formation of water soluble lignin fragments

Lignin degradation

Mean enzyme activity increases with progressing decay

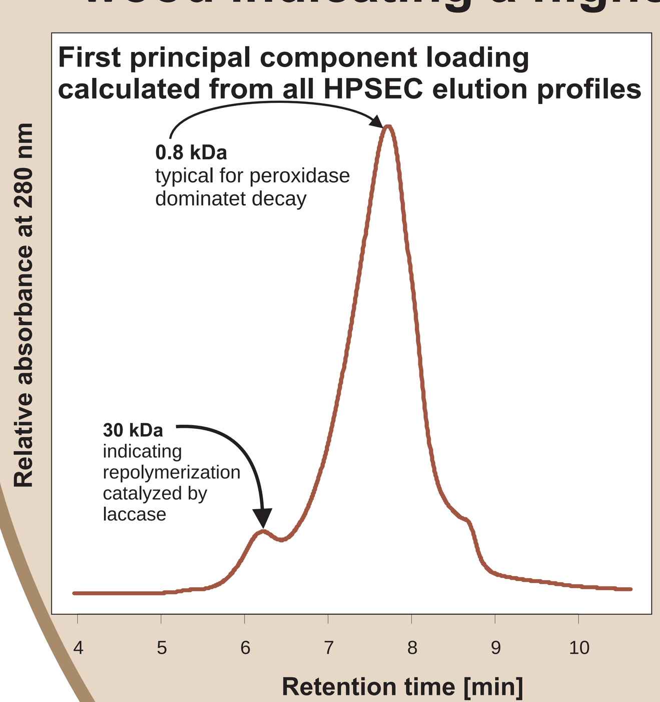
- mean enzymatic activity increases from decay stage 1 to decay stage 4 and decreases again in decay stage 5
- laccase and manganese peroxidase show the highest oxidative activities and represent the most abundant oxidoreductases secreted by white-rot fungi

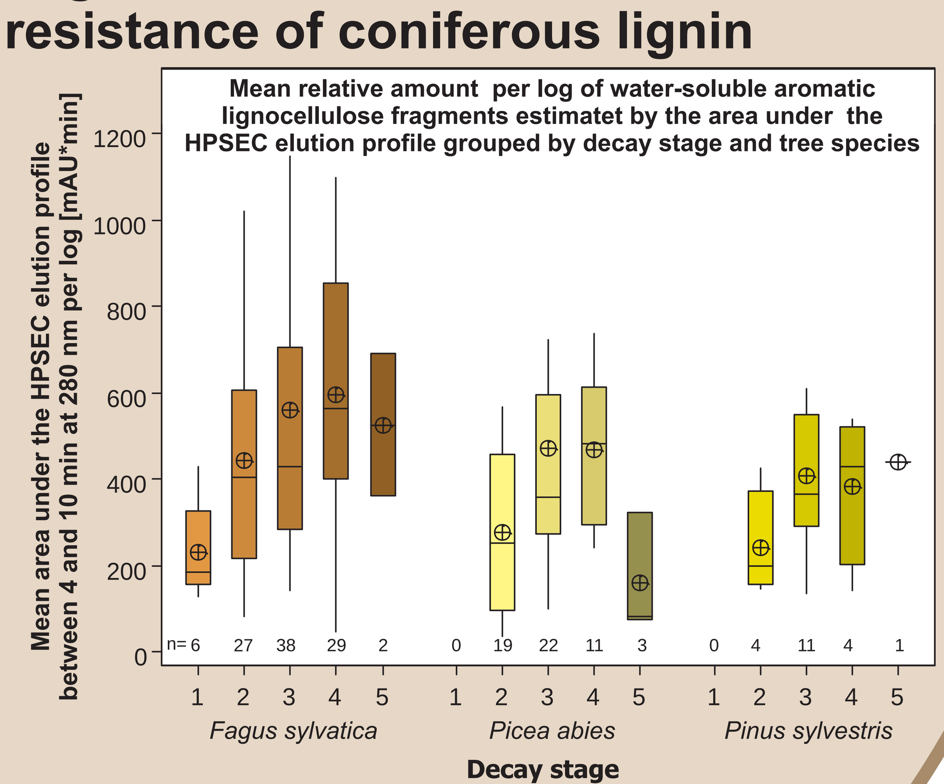


Enzyme activities: The frozen wood samples were milled and extracted with water. The enzyme activities in the extract were determined by following the oxidation of ABTS (420 nm). Manganese peroxidase activity (MnP, EC 1.11.1.13) was detected in the presence of Mn^{2+}. Activities of manganese-independent peroxidase (MiP) as well as of laccase (Lac, EC 1.10.3.2) were measured in the presence of EDTA to chelate manganese ions naturally occurring in wood. To distinguish between oxidase (Lac) and peroxidase activities, reactions were performed with and without H_2O_2.

Formation of soluble lignin fragments increases with progressing decay

- the average amount of water-soluble aromatic lignocellulose fragments increases with processing decay (except in stage 5)
- in coniferous wood, less fragments are formed than in beech wood indicating a higher resistance of coniferous lignin



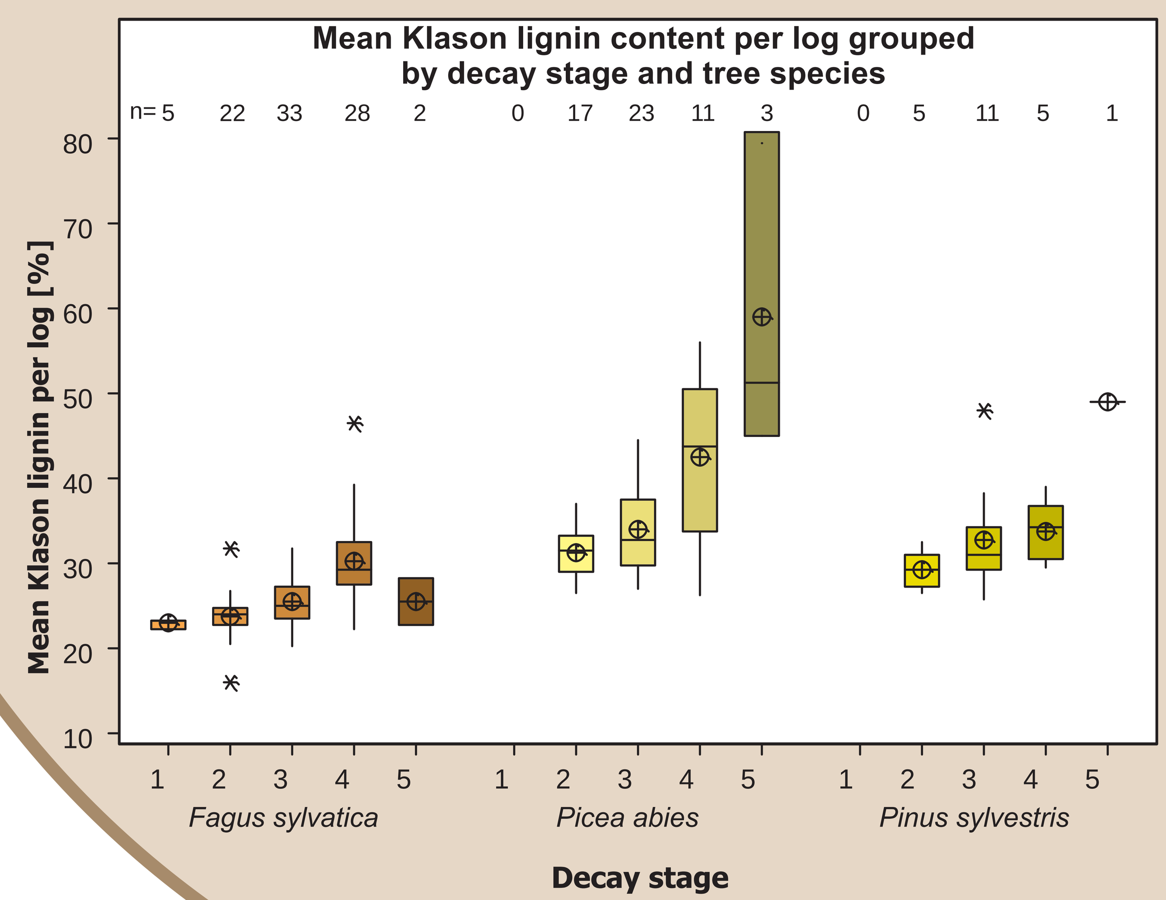


- first principal component loading of all HPSEC elution profiles indicates that white-rot is mainly peroxidase driven with a small influence of laccase

Molecular mass distribution of water-soluble aromatic lignocellulose fragments: The frozen wood samples were milled and extracted with water. The aqueous extracts were analyzed by high performance size exclusion chromatography (HPSEC) using a linear HEMA-Bio column (Polymer Standard Service, Mainz). Chromatograms were recorded at 280 nm. All chromatograms where analysed using principal component analyses in R.

Variation in lignin content increases with progressing decay

- Variation in the Klason lignin content increases with progressing decay indicating the rise of different decay types (brown rot, simultaneous and selective white rot, soft-rot)
- late decay stages of coniferous wood (*Picea abies* & *Pinus sylvestris*) show still a high Klason lignin content, which indicates a dominance of brown-rot



Klason Lignin was determined according to Effland (1977). The samples were ground to a powder and extracted with acetone using accelerated solvent extraction (ASE). Then a two-step hydrolysis was carried out with sulfuric acid. After washing and drying the solid residues where weight out as Klason lignin.

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