Degradation of dibenzofuran and dibenzodioxins by fungi

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The white-rot fungus *Phanerochaete chrysosporium* has been reported to oxidize chlorinated aromatic pollutants including dibenzodioxins[1,2]. This ability of *P. chrysosporium* is connected with its capacity to degrade lignin. Both lignolysis and pollutant oxidation are secondary metabolic events occuring in response to nitrogen limitation[1].
In order to isolate microorganisms with a high capacity for decontamination of dioxin-polluted soils, we investigated approximately 150 strains of fungi from culture collections or newly isolated from nature.

Strains used in this study were derived from the Greifswald culture collection of fungi with exception of the *Fusarium* species. *Fusarium* strains were newly isolated from soil samples. The N-limited medium of Kirk et al.[3] was used in degradation experiments with *Phanerochaete chrysosporioum* and other white-rot fungi. A mineral salt medium[4] was employed in experiments with all other fungi. In each case, 100 mg per l of dibenzofuran were added to the assays. The fungi were cultivated in shaking flasks at 28°C. The formation of metabolites was analyzed in the cell-free culture supernatants after 5 to 15 days of cultivation by reversed phase HPLC and GC/MS.
The oxidation of dibenzofuran, dibenzodioxin, chlorinated dioxins and other aromatics by whole cells of *Fusarium redolens* was determined manometrically at 30°C in 0.066 M potassium phosphate solution, pH 4.5.

Incubations of soil samples from different sources (meadows, forests, roads) in mineral salt medium containing dibenzofuran provided only fungi of the genus *Fusarium*, which were determined as *F. redolens* and *F. solani*.
These two and 13 strains from the Greifswald culture collection are able to grow in the presence of dibenzofuran.
As shown in Fig. 1, cells of *Fusarium redolens* precultivated for 3 days in the presence of glucose as a source of carbon and energy oxidized dibenzofuran, dibenzodioxin, mono- and dichlorinated derivatives of dibenzodioxin as as well as other aromatics at a relatively high rate.

Fig. 2 shows the HPLC elution profiles of metabolites formed from *Paecilomyces marquandii* and *Fusarium redolens*. In both cases and in experiments with other fungi (results not shown), the most significant products formed from dibenzofuran were 2-hydroxydibenzofuran and other hydroxydibenzofurans not yet identified.
From these results, the conclusion was drawn that not only white-rot fungi but obviously many others are able to degrade dibenzodioxins and related compounds.
Therefore, further studies must be made to find out the metabolic fate of these xenobiotics and the mechanisms of their degradation.

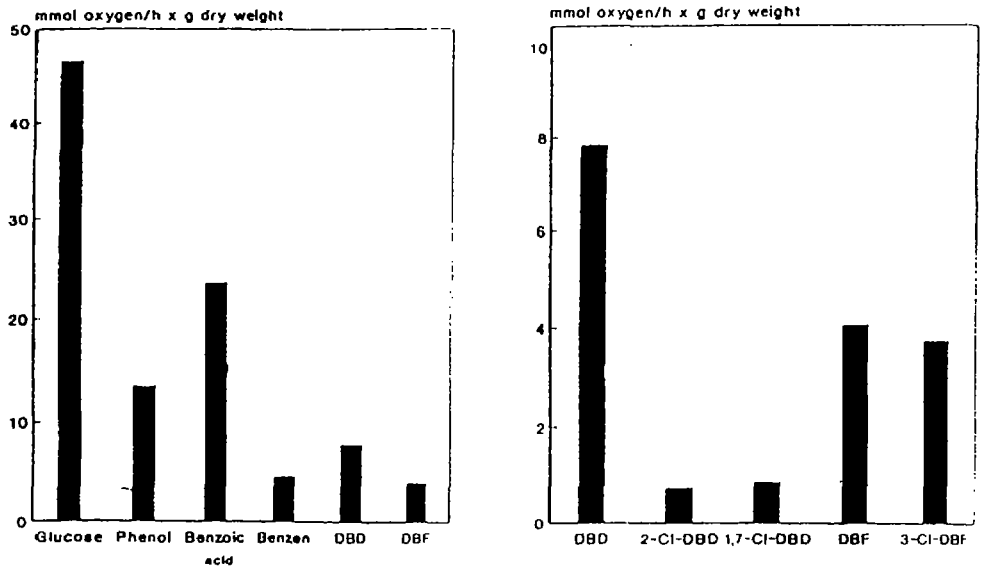

Fig. 1. Oxidation of dibenzofuran, dibenzodioxin, chlorinated dibenzodioxins and other aromatics by cells of *Fusarium redolens*.
The cells were cultivated for 3 days in mineral salt medium containing 1% glucose. DBD: dibenzodioxin., DBF: dibenzofuran.

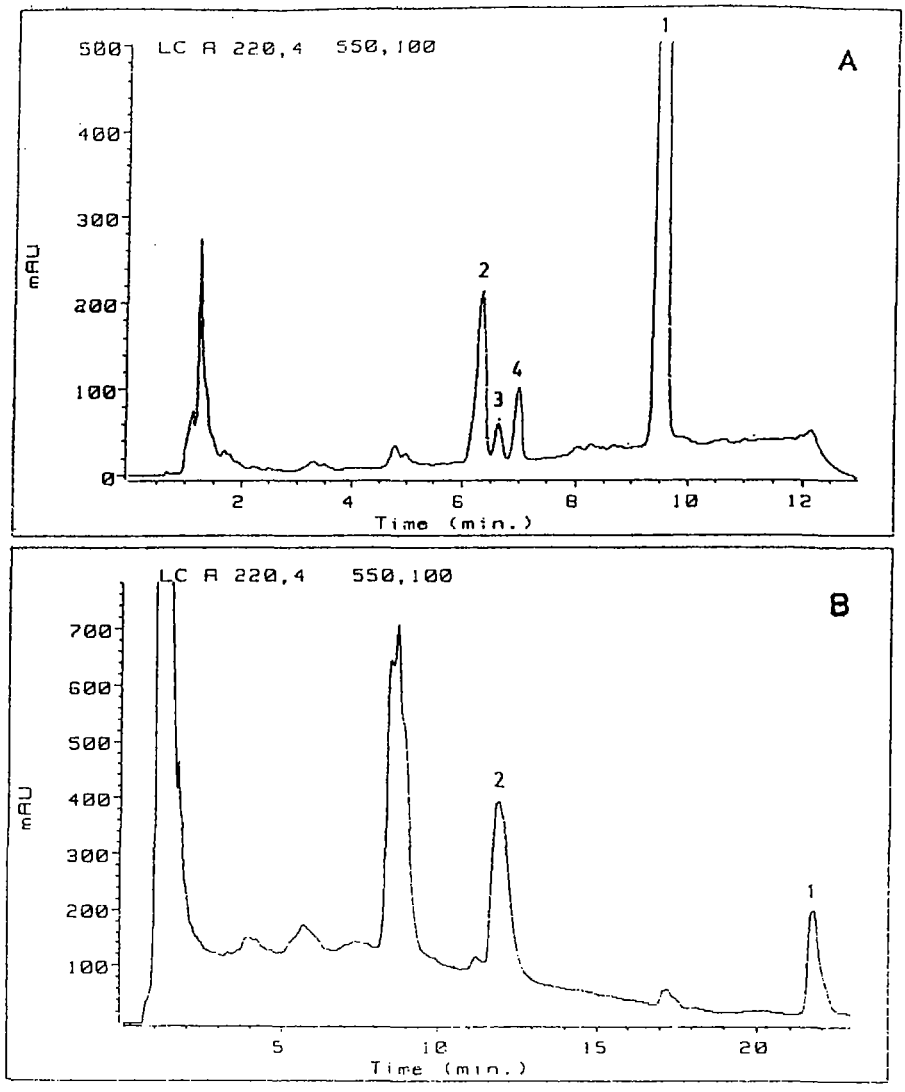

Fig. 2. HPLC elution profiles of metabolites formed from dibenzofuran by (A) *Paecilomyces marquandii* and (B) *Fusarium redolens*.
P. marquandii was cultivated for 7 days in N-limited medium and *F. redolens* in mineral salt medium in the presence of 0.1 % (w/v) dibenzofuran. 1: dibenzofuran, 2: 2-hydroxydibenzofuran, 3 and 4: other hydroxydibenzofurans not yet identified.

Table 1. Fungi with dibenzofuran-degrading capacity

Soil fungi

1. Zygomycetes

Mucor hiemalis Wehmer

2. Ascomycetes

Chaetomium globosum Kunze: Fr.
Phoma spec.

3.Deuteromycetes (Fungi imperfecti)

Fusarium redolens Wollenweb. [*F. oxysporum* Schlecht.: Fr.s.l.]
Fusarium solani (Martius) Sacc.
Paecilomyces marquandii (Massee) Hughes
Papulaspora spec.

White-rot fungi

1. Basidiomycetes

Inonotus radiatus (Sow.: Fr.) Karst
Lentinus tigrinus (Bull.:Fr.) Fr.
Phanerochaete chrysosporium Burdsall
Polyporus badius (S.F.Gray) Schw.
Pycnoporus cinnabarinus (Jacq.: Fr.) Karst.
Schizophyllum commune Fr.: Fr.
Trametes hirsuta (Wulf.: Fr.) Pil.
Trametes versicolor (L.: Fr.) Pil.

References

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