Abstract

Polychlorinated biphenyls (PCBs) are chlorinated organic compounds, which belong to persistent organic pollutants and exhibit various modes of toxic action, including mutagenicity, carcinogenicity, and endocrine disruption. PCBs were manufactured during the 20th century in many countries and extensively used due to their advantageous physicochemical properties. PCBs mostly served as insulating liquids in electrical equipment; however, they were also utilized in many open applications. Despite the worldwide ban on PCB manufacture imposed at the end of the 20th century, the contamination of the environment persists to this day as a result of their recalcitrance. Moreover, PCBs are still being inadvertently produced during many industrial activities.

Because of their stability, the breakdown of PCBs in nature is extremely slow. This dissertation thesis focuses on the study of PCB biodegradation by ligninolytic fungi. This group of microorganisms belongs to the most promising, especially in regard to the degradation of organic pollutants. The biodegradation mechanism of PCBs was studied *in vitro*, including the identification of degradation intermediates. Laccase, an enzyme expressed by the oyster mushroom (strain *Pleurotus ostreatus* 3004), was able to degrade hydroxylated PCBs. In addition, chlorinated benzylalcohols were transformed to corresponding chlorobenzaldehydes by the extracellular enzymes produced by this fungal strain. The chlorobenzaldehydes were transformed further by extracellular peroxidases produced by the strain *Irpex lacteus* 617/93. Furthermore, a part of the dissertation thesis involves the evaluation of the potential of utilizing spent oyster mushroom substrate to remove PCBs from historically contaminated groundwater. This waste material is produced and disposed of by commercial mushroom farms, but it can be repurposed as inoculum for bioremediation applications. In a pilot-scale setup, the spent substrate was able to remove 82, 80, 65, and 30–50% of di-, tri-, tetra-, and pentachlorinated PCBs, respectively, from groundwater (4000 liters). Chlorobenzoic acids were detected as intermediates. Acute toxicity was evaluated using the bioluminescence inhibition test with *Aliivibrio fischeri*.