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The use of the fungus *Dichomitus squalens* for degradation in rotating biological contactor conditions

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ABSTRACT

Biodegradation potential of *Dichomitus squalens* in biofilm cultures and rotating biological contactor (RBC) was investigated. The fungus formed thick biofilms on inert and lignocellulosic supports and exhibited stable activities of laccase and manganese peroxidase to reach 40–62 and 25–32% decolorization of anthraquinone Remazol Brilliant Blue R and heterocyclic phthalocyanine dyes, respectively. The decolorization ceased when glucose concentration dropped to 1 mmol l^{-1}. In RBC reactor, respective decolorizations of Remazol Brilliant Blue R and heterocyclic Methylene Blue and Azure B dyes (50 mg l^{-1}) attained 99%, 93%, and 59% within 7, 40 and 200 h. The fungus exhibited tolerance to coliform and non-coliform bacteria on rich organic media, the inhibition occurred only on media containing tryptone and NaCl. The degradation efficiency in RBC reactor, capability to decolorize a wide range of dye structures and tolerance to bacterial stress make *D. squalens* an organism applicable to remediation of textile wastewaters.

1. Introduction

White-rot fungi have been recognized as microorganisms with important degradation potential that can be exploited for bioremediation of industrial effluents in the form of biofilms immobilized on solid surfaces applicable in various types of reactors (Knapp et al., 2008; Rodríguez Couto, 2009). A general need for new robust strains with a broad degradation range, resistant to toxic and bacterial effects and usable in fungal bioreactors in a long-term regime exists (Singh, 2006). Our study focused on *Dichomitus squalens* whose significant biodegradation potential has been shown (Gill et al., 2002, etc.) but has not so far been tested in chemically-engineered bioreactors (e.g. Rodríguez Couto, 2009; Singh, 2006).

D. squalens belongs to WRF that express predominantly MnP and laccase but not LiP (Hatakka, 1994), its liquid and soil cultures were shown to degrade a range of pollutants, PAHs, synthetic dyes and endocrine-disrupting compounds (Cajthaml et al., 2009; Covino et al., 2010; Eichlerová et al., 2006). Tolerance to bacterial stress is important if a fungal organism is to be used for bioremediation as most processes have to be run under nonsterile conditions. The tolerance of *D. squalens* is not known. The fungus was found not to be able to colonize nonsterile soil and the syntheses of laccase and MnP were decreased in the presence of soil organisms, but its biochemical activity measured by decomposition of straw continued under those conditions (Lang et al., 2000).

The conditions in RBC reactors in both repeated-batch and continuous mode are generally suitable for the use of WRF for biodegradation, RBCs advantages include simple construction, great surface area per unit volume, low power requirement and no flow clogging (e.g. Alleman et al., 1995; Nilsson et al., 2006). Several WRF, for instance *Phanerochaete chrysosporium*, *Trametes versicolor* and *Bjerkandera* sp., have been shown to degrade chlorophenols, PAHs and synthetic dyes as well as to decolorize and detoxify Kraft and bleach plant effluents when used in RBC (e.g. Alleman et al., 1995; Axelsson et al., 2006). Plastic, metal-mesh and wooden disks are normally used as carriers in RBC, hydraulic retention times being 2–3 d and dye concentrations typically not exceeding 200 mg l^{-1} (Kapdan and Kargi, 2002; Nilsson et al., 2006). To our knowledge, the biodegradation potential of *D. squalens* has so far not been tested under the conditions of a RBC-type reactor.

Abbreviations: AB, Azure B; BPB, Bromophenol Blue; CFU, colony forming units; CR, Congo Red; CuP, Cu-phthalocyanine; DB3, Disperse Blue 3; LiP, lignin peroxidase; MEG, malt extract-glucose medium; MnP, manganese-dependent peroxidase; MB, Methylene Blue; MM, mineral medium; NBB, Naphtol Blue Black; PAHs, polycyclic aromatic hydrocarbons; PDA, potato dextrose agar; RBC, rotating biological contactor; RB5, Reactive Black 5; RBBR, Remazol Brilliant Blue R; RO16, Reactive Orange 16; WRF, white rot fungi.

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