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TEXTILE DYES FUNGAL MECHANISMS OF BIODEGRADATION

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Reactive dyes are widely used in the textile industry. Coloured effluents from dyestuff and textile industries, the major producers and users of azo dyes, not only produce visual pollution but can also be detrimental to life, as they are usually resistant to biological treatment. Additionally, fungi, mainly white rot fungi, have shown the ability to degrade numerous aromatic organopollutants, including textile dyes, via oxidative mechanisms till their complete mineralisation, avoiding the formation of anilines as intermediates. In our work, textile mono-azo dyes were synthesised using aminobenzoic and aminosulphonic acids as diazo components and bioaccessible groups such as 2-methoxyphenol (guaiacol) and 2,6-dimethoxyphenol (syringol) as coupling components (Figure 1).

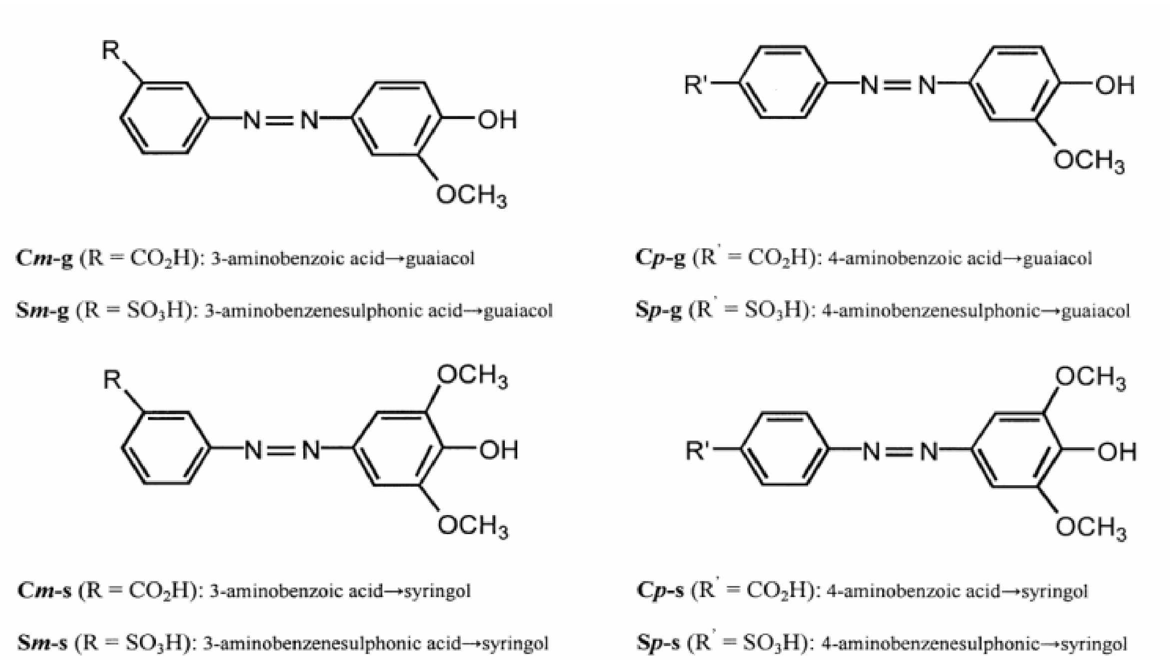

Figure 1. The eight mono-azo dyes synthesised and their chemical structures. The nomenclature presented in this figure, expressing the diazo component -> coupling component, is used in textile chemistry to suggest the synthesis process. The sigla used refer the kind of acid (carboxylic—C or sulphonic—S), its position relative to the azo bond (meta–m or para—p) and also the coupling component (guaiacol—g or syringol—s).

The bioaccessible groups are present in the lignin structure and seem to be access points to the ligninolytic enzymes produced by white rot fungi. The fungal biodegradation of the azo dyes were studied in order to establish the relationship between the chemical structure of the dye and the extent of biodegradation. The rule of the non-specific fungal ligninolytic enzymatic system, lignin peroxidises (LiP), manganese peroxidises (MnP) and laccases (Lcc), as well as the enzyme glyoxal oxidase wich produce H_2O_2 for the activities of both peroxidases were studied. The di-azo Reactive

Black 5 and the anthraquinone-based polymeric dye Poly R-478 have been currently used to screen the fungal biodegradation under alkaline conditions (pH $\geq$ 8.0). In order to adapt the fungi to this alkaline condition a chemostat is now used. To perform this work the *Trametes versicolor* MUM 94.04, MUM 04.100, MUM 04.101 MUM 04.104 and MUM 04.105, *Pleurotus ostreatus* MUM 94.08, *Phanerochaete chrysosporium* MUM 94.15 (ATCC 24725) and MUM 95.01, *Irpex lacteus* MUM 98.04, *Bjerkandera adusta* MUM 99.04, *Fomes fomentarius* MUM 04.102 and *Ganoderma applanatum* MUM 04.103 were used and were supplied by the culture collection Micoteca da Universidade do Minho (MUM). As a conclusion, the results show a relationship between the extent of biodegradation and the chemical structure of the dyes either to be degraded or to be used in the pre-growth medium. The identification of two hydroxylated metabolites from the degradation of the most degraded dye, allowed the proposition of a metabolic pathway either when *T. versicolor* was used or *Phanerochaete chrysosporium*. Using these fungal bioaccessible azo dyes and due to the oxidative fungal mechanisms, no hazardous anilines, resulting from reductive cleavage of the azo bond were detected. The results obtained point to the advantages of the possible use of this ''green'' bioaccessible dyes in the textile industry, thinking of a biological effluent treatment using ligninolytic fungi. Finally, *T. versicolor* proved to be the most suitable fungus for the degradation of the dyes studied under alkaline conditions and the current results open the possibility to use chemostat to adapt the fungus to these conditions.