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Vanillic Acid Metabolism by Micromycetes

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ABSTRACT

In a study of fungal degradation of compounds related to lignin, 650 Micromycetes have been cultivated on vanillic acid (Va). Solid cultivation technique on malt–agar showed that this compound has a very low toxicity for many studied species and is well-assimiliated up to relatively high concentrations (1 g/L). Few toxic effects have been observed on growth and differentiation; only 9% of the strains were unable to grow on this medium.

The amount of consumed vanillic acid, the sole carbon source, has been determined after cultivation on solid mineral medium: 451 strains belonging to various genuses showed a good growth on this medium. Fungi have been classified according to their ability to grow on this substrate.

169 strains among the 451 selected fungi have been cultivated in liquid medium. Culture filtrate analysis with thin layer chromatography and mass spectrometry allowed classifying them according to their observed metabolic pathways. Complete consumption of vanillic acid was accomplished by 65 strains, 19 of them without any detectable intermediate product, the others producing various metabolites. Limited consumption of vanillic acid with metabolization of this molecule has been observed wih 76 strains. Only 28 fungi showed a weak consumption of Va. Demethylation of Va to protocatechuate has been demonstrated for 20 fungi, nonoxidative decarboxylation to guaiacol by 3 strains, and oxidative decarboxylation to methoxyhydroquinone for 23 strains. Polymerization reactions also occurred in the culture solutions.

According to these observations, fungi have been classified into 15 categories following 15 different metabolic pathways and one strain from each category has been studied in more detail. Comparative studies of mycelium and medium extracts allowed us to suppose that both cell-bound and cell-free enzymatic systems are involved in these pathways.

A scheme for the metabolism of vanillic acid by 160 fungi based upon the results obtained with this substrate is proposed. This work is part of a study on biotransformation activities of our Micromycetes strains in the presence of seven phenolic substrates (phenol, catechol, guaiacol, vanillic acid, protocatechuic acid, syringic acid, and ferulic acid).