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Assignment	
Topic	introduction to bacterial and fungal species for bioremediation
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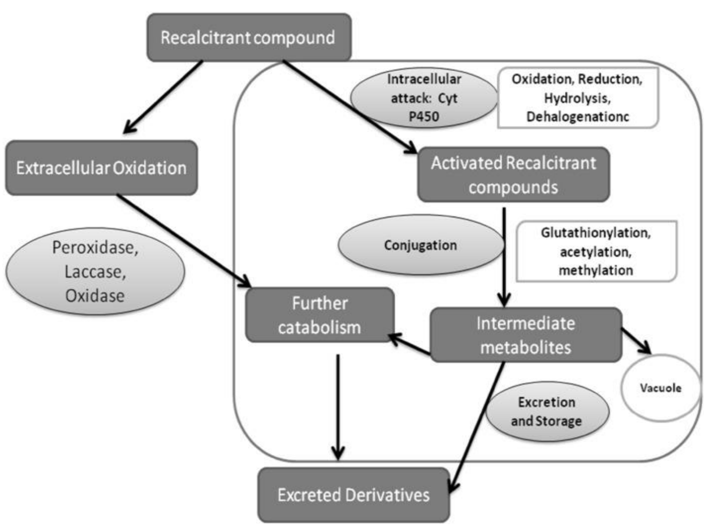
Introduction to bacterial and fungal species for bioremediation

The nature is a huge ecological niche to fungi and bacteria which play an important role as decomposers of dead materials and converts organic matters into carbon dioxide and mineral molecules. Microorganisms have evolved a high degree of metabolic versatility that allows them to use a diverse range of organic substrates and large molecules from different complex chemicals present in nature such as hydrocarbons via activity of fungi which carbon source for their metabolic pathways in glycolysis needs process to produce primary and secondary metabolites

Fungi are an important part of degrading microbiota because, like bacteria, they metabolize dissolved organic matter; they are principal organisms responsible for the decomposition of carbon in the biosphere.

Use of fungi in bioremediation

Fungi are among the potential candidates of bioremediation as they are natural decomposers of waste matter and secrete several extracellular enzymes capable of decomposing lignin and cellulose, the two essential components of plant fiber. Achieve a successful mycoremediation. White-rot fungi possess a number of advantages in relation to degradation of insoluble chemicals and toxic environmental pollutants that can be exploited in bioremediation systems. The accessibility and bioavailability of the pollutants serve as a limitation in bioremediation including fungal-mediated bioremediation of pesticides.



Mechanisms adopted by fungi for bioremediation of toxic, recalcitrant compounds

White-Rot Fungi

White-rot fungi are chief agents of biodegradation of ligninnous material in nature which contribute in the global carbon recycling. Endocrine disrupting chemicals (EDCs) and TrOCs such as pharmaceuticals and personal care products (PPCPs) which can result in effects such as bioaccumulation, acute and chronic toxicity to aquatic organisms, and possible adverse effects on human health have generated a lot of interest with reference to their degradation by white-rot fungi. Majority of the studies have demonstrated the bioremediation potential of white-rot fungi; Phanerochaete chysosporium, Trametes versicolor, Bjerkandera adjusta and Pleurotus sp., by virtue of producing different ligninolytic enzymes such as laccases and peroxidases

Marine Fungi

The potential of marine fungi for production of secondary metabolites, biosurfactants, novel enzymes, polysaccharides and polyunsaturated fatty acids in addition to their application in bioremediation of hydrocarbons and heavy metals has been well documented [30]. Their ability to adapt to high saline conditions and pH extremes provides a biological advantage to these fungi over terrestrial fungi. The efficiency of marine microbes for metal ion removal points towards the promising nature of extremophilic organisms for bioremediation as well as in nanotechnology.

Extremophilic Fungi

Fungi from extreme environments are very important from industrial point of view owing to their extremophilic enzymes which possess several special characteristics such as thermotolerance, pH tolerance, and tolerance to other harsh conditions [44]. Amongst the extreme environments, effluent treatment plant represents one such potential niche which could be targeted for fungi with capacity for diverse bioremediation applications, owing to their exposure to high levels of pollutants from industrial effluents.

Symbiotic Fungi with Plants and Bacteria

Fungi are known to forge close association with plants and bacteria in order to overcome the barrier of restricted growth under different environmental conditions. Arbuscular mycorrhizal fungi (AMF) represent the most common symbiotic relationship between fungi and plants wherein, fungal partner promotes pollutant removal by providing higher surface area for absorption of pollutants through its hyphae and spores by mobilizing the pollutants and binding to the root.

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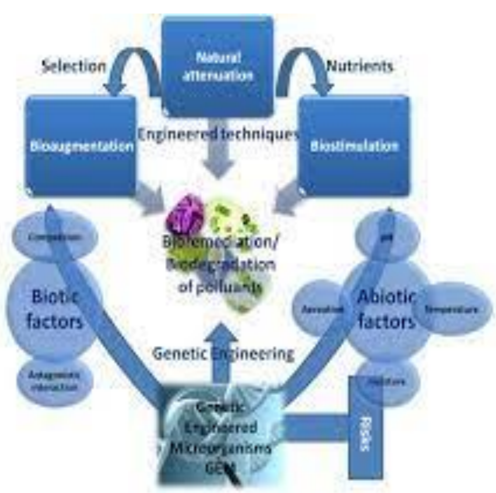
Fungi have been shown to play a significant role in bioremediation of variety of pollutants such as POPs, textile dyes, petroleum hydrocarbons, pulp and paper industry effluents, leather tanning effluents, PAHs, pesticides, PPCPs Filamentous fungi like Aspergillus, Curvularia, Acrimonium and Pithium have been studied for their metal tolerance ability

Use of bacteria in bioremediation

Besides, bacteria are also efficient in heavy metals bioremediation. Microorganisms have developed the capabilities to protect themselves from heavy metal toxicity by various mechanisms, such as adsorption, uptake, methylation, oxidation and reduction

Below are several specific bacteria species known to participate in bioremediation

- Pseudomonas putida.
- Dechloromonas aromatica.
- Deinococcus radiodurans.
- Methylibium petroleiphilum.
- Alcanivorax borkumensis.
- Phanerochaete chrysosporium.



Bacteria that can degrade some soil contaminants such as chlorinated hydrocarbons are used in bioremediation. Bacteria produce iron-chelating substances called siderophores which enhances mobility and reduces bioavailability of metals and its subsequent removal from soil. Sulphate-reducing bacteria such as Desulfovibrio desulfuricans have the ability to convert sulphate to hydrogen sulphate which then reacts with heavy metals such as Cd and Zn to form insoluble forms of these metal sulphides

Bacteria are essential biosorbents for the treatment of polluted environments because they are able to grow under controlled conditions and can withstand intense environmental conditions. They act as good biosorbents for heavy metals from polluted environments. Likewise, fungi are able to withstand and detoxify metal ions by active accumulation, intracellular and extracellular precipitation, and valence transformation, hence they are potential biocatalysts for the bioremediation of heavy metals as they are able to absorb heavy metals into their mycelium and spores