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Yarrowia lipolytica in bioremediation

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For the management of a diverse group of environmental pollutants, many treatment methods are used, out of which bioremediation acts as a sustainable approach. Bioremediation is a branch of biotechnology that involves microorganisms to facilitate the degradation of environmental pollutants into less toxic forms or to encourage the removal of contaminants to appropriate levels of concentration. It is used to clean up oil spills or groundwater that is contaminated. The success of microorganisms in destroying man-made contaminants depends on the type of organisms, the type of contaminant, and the geological and chemical conditions at the contaminated site. Yarrowia lipolytica, a yeast strain is considered a potential agent in bioremediation. It has the potential to rapidly degrade and oxidise hydrophobic substrates (HS), such as fats, oils, alkanes and fatty acids. The growth of microorganisms in hydrophobic substrates requires interaction between the organic phase (hydrophobic substrate surface) and the surface of the cells. This may occur through two mechanisms, such as direct adsorption of hydrophobic droplets on the surface of the cell and the action of biosurfactants. Both these mechanisms are found in the Y. lipolytica, which makes it a model organism to study the metabolic mechanisms involved in the metabolism of HS, including the processes of transport of hydrophobic substrates, recognition and regulation of genes involved in these processes. Given this ability to use substrates that are hydrophobic, Y. lipolytica strains have emerged from many independent trials as a very promising agent for the treatment of both mineral oil contamination and plant oil waste.

A recent study on Y. lipolytica's capacity has revealed another important finding with respect to bioremediation. In the presence of numerous carbon sources, including alkanes, Y. lipolytica can form biofilms. Under natural conditions and during the treatment of various pollutants, this ability to form biofilms may be of importance. Microbes are often present as biofilms during bioremediation experiments and in waste management procedures. Cells in biofilms have better protection within the matrix and therefore have a better chance of adaptation and survival under duress. There is also a lot of literature on the assessment of indigenous yeasts associated with natural detoxification processes of a wide variety of pollutants. Several strains of Y. lipolytica have been discovered and isolated from several contaminated environments. The native microbial communities present in such a contaminated environment are under constant duress due to the existence of toxins and have therefore evolved such that detoxification efficiency has been gained by their enzyme configuration. One of the most notable characteristics of Y. lipolytica that can be exploited for bioremediation is the presence of several multigene families. This multiplicity of genes is the foundation of the enzymatic steps involved in HS degradation in this yeast, for a wide variety of substrate and chain-length specificities. This can be utilised to degrade a large spectrum of pollutants. All the above-mentioned research and literature point towards the fact that Y. lipolytica can be regarded as a promising potential agent in bioremediation for the degradation of oil waste contamination.

Keywords: Y. lipolytica, Bioremediation, Hydrophobic substrates, Oils, Pollutants

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