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Review Article

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An Environmental Friendly Perspective of Microbial Degradation

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Abstract

In the recent years attempt to find cost-effective and ecological ways to deal with noxious waste led mankind to focus on the use of microbes for the degradation of pollutants. These environmental friendly remediation methods employs the microbial naturally occurring catabolic capabilities to alter, vitiate or accrue a large number of pollutants including poly aromatic hydrocarbons, polychlorinated biphenyls, radio nuclides ,heavy metals etc. High-through put analyses of environmentally relevant microbes provides an insight of their major degradative pathways as well as their competence to acclimate to altering environmental conditions.

Keywords: Rhodococcus, Flavobacterium, Kerosene, Redox reactions, Volatile organic compounds.

Introduction

An astounding increase in population rate will inexorably cause an accretion of water, air and soil pollution. According to a recent estimate 1.3 billion tons of waste is produced annually and a large proportion of it is being stored in land fill sites or discarded into the oceans [1]. Numerous intensive and extensive cleaning technologies have been employed but such procedures are expensive not that environmental friendly. Therefore bio based approaches have been adopted for the remediation of a wide range of organic and metallic pollutants generating less harmful residues [2]. Use of different microorganisms for pollutant degradation is an emerging and innovative aspect of environmental biotechnology either using the whole microbial cell as degrading system or its isolated bio components to abate pollution from the environment [3]. Microbes have the capability to transmute the assembly of pollutants through their natural metabolic routes [4]. Microbes either degrade or chelate contaminants to make them less available to the environment. Thus making microbial bioremediation as an effective clean up technology [5]. Microbial remediation is done either by introducing cultures of specific microbes at contaminated sites or by means of establishing ideal conditions for microbes in the affected area to accelerate their growth rate [6]. Numerous microorganisms such as *Acinethobacter, Actinobacter, Bacillins, Flavobacterium, Mycrobacterium, Mycococcus, Nitrosomonas, Penicillium, Pseudomonas, Rhizoctomia, Serratio, Trametes* etc have been involved in the degradation of pollutants [7, 8]. However factors such as contaminant unavailability, level of microbial tolerance to contaminant toxicity, partial degradation and other a biotic conditions may complicate the degradation process if not monitored [9]. But above all microbial bioremediation offers tremendous advantages such as no harmful intermediates are produced, feasible remediation of aromatic compounds, economically sustainable, cost effective, eco-friendly etc [10]. Microbes transform organic contaminants by utilizing it as a source of carbon and electrons required for their growth and survival .By catalyzing energy-producing redox reactions, microbes obtain their energy [11].

Microbial degradation of environmental pollutants

Air pollutants

Major air pollutants includes particulate, ground-level ozone, oxides of sulfur and nitrogen dioxides, polycyclic aromatic hydrocarbons, smoke, benzenes, toluene, xylenes, unburnt hydrocarbons and volatile organic compounds [12,13]. Organisms involved in the bioremediation of such pollutants includes Rhizobium, *Azotobacter, mycorrhizas* Cyanobacteria such as *Nostoc, Scytonema, and Stigonema, Nitrosococcus, Nitrobacter, Nitrosomonas, Phyllosphere diazotrophic bacteria, Beijerinckia, Beggiatoa, Paracoccus , Archaeoglobus, Desulfotomaculum, Methylobacterium extorquens, Rhodococcus rhodochrous, Alcaligenes xylosoxidans, P. putida , Cladophialophora species, Bacillus cereus etc* [14-18].

Water pollutants

Major water pollutants includes petroleum based products such as gasoline, diesel, kerosene, lubricating oils, NP based fertilizers, chlorinated solvents such as carbon tetrachloride, Freons, benzene, toluene, xylenes, acetone, methyl ethyl ketone, alcohols such as ethanol, isopropanol; or oxygenate compounds such as MTBE, antibiotics, pharmaceutical products, metals such as Hg, Cr, pesticides/insecticides/herbicides, radionuclides, plastics etc [19-22]. Organisms involved in the bioremediation of such pollutants includes *Bacillus pumilus, Brevibacterium sp, Pseudomonas aeruginosa, hydrocarbonoclastic bacteria, Alcanivorax borkumensis, Micrococcus, Rhodococcus. Chromobacterium, Pseudomonas pudita, Candida, Saccharomyces, Acinetobacter, Rhodococcus sp, Xantobacter autophicus, Athrobacter, Pseudomonas stutzeri,*

Pseudomonas mendocina, Psudomonas ovals, Alcaligenesetc [23-32].

Soil pollutants

Soil pollutants include arsenic, zinc, copper, fertilizers, herbicides, insecticides, lead, mercury, nickel, treatment of toxic wastes. Annual Reviews in Microbiology 48: 525-557.

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