

Chapter 13

Application of Potential Biological Agents in Green Bioremediation Technology: Case Studies

Debajyoti Kundu

University of Kalyani, India

Deblina Dutta

University of Kalyani, India

Subinoy Mondal

The University of Burdwan, India

Smaranya Haque

The University of Burdwan, India

Jatindra Nath Bhakta

University of Kalyani, India

Bana Behari Jana

University of Kalyani, India

ABSTRACT

Upgradation and advancement in every field related to mankind leads to the origin of a contaminated environment. Development in science and technology enabled humans to combat the rate of contaminants by using biological agents, commonly known as bioremediation. The chapter deals with the different species of bioremediation agents viz. bacteria, fungi, algae, plants, animals and organic wastes to treat diverse environmental pollution. The extent of environmental bioremediation encompasses inorganic viz. arsenic, chromium, mercury, cyanide etc. and organics viz. Hydrocarbons, petroleum, pesticides etc. Thus, the reasons for the control of water and soil by considering bioremediation are concern on public health, protection of environment, and cost reduction of decontamination. Different case studies have been demonstrated herein to understand the enigmatic process and evaluate practical efficacy of the environment to decontaminate itself by the presence of various biological organisms.

INTRODUCTION

Expeditious growth of population and their anthropogenic activities in industry, agriculture and domestic sectors leads to the generation of huge hazardous toxic materials. These toxic elements can persist in the environment for a long time. Thus, continuous generation along with long persistence make a

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favorable condition for pollutants to accumulate in different matrices (air, water and soil). This filthy condition is gradually capturing our world with its adverse effect on the human health. Hence there is an utmost requirement to combat with the pollution load for our better health and environment. There are several processes to deal with the contaminants, among them biological process is recently gaining popularity for its eco-friendly nature. Nature teaches us different remedies to manage any type of condition. Development in scientific research, scientists are able to develop efficient and economic processes for remediation of contaminants (Elekwachi et al., 2014). Use of biological agents like plants, animals, algae, fungi, microbes, etc. in pollution abatement is commonly known as bioremediation. Some species of plants, animals, algae, fungi, microbes, etc. also increases in certain places so as to make them highlighted by being polluted.

The principle of bioremediation involves the biological organisms to wipe out the contaminants or convert them into less harmful variety by formation of porous fence, intra and extracellular confiscation, active transport, enzyme mediated detoxification, chelation of metals, precipitation through the production of organic harmless substances and biotransformation reactions (methylation, oxidation, reduction and volatilization). They multiply themselves by generating energy and nutrients from the atmosphere. In very few cases, the nature provides all the essential materials for cleaning up the contaminated sites, known as intrinsic bioremediation. But in most of the cases, essential materials are regularly supplied from an outer source to the organisms, this process is known as engineered bioremediation. These two types can further be classified under different techniques viz. biostimulation i.e., by stimulating viable native microbial population; bioaugmentation i.e., artificially introducing viable population; bioaccumulation i.e., applying live cells; biosorption i.e., using dead microbial biomass; phytoremediation i.e., by using various species of plants and rhizoremediation i.e., by using plant and microbes at the same time (Chowdhury et al, 2012). Different species of these agents are used to identify pollution as well as treat diverse environmental pollution. Inorganic, organic as well as air pollutants can be treated through bioremediation. Aquatic plants also act as biosensor and help in the remediation of polluted water. It is an interesting fact that besides plants and microbes, soil animals like protozoans, nematodes, earthworms, mites, insect larvae, arachnids, millipedes and centipedes are also involved in bioremediation. They usually play a very regulative role in the decomposition rate of the contaminants. The process of bioremediation is very simple and very cost effective usually driven by the solar energy (Prasad, 2011). The only part for effective bioremediation includes the proper selection of biological species for a definite problem of contamination in polluted sites may it be land or water. Progress in various paths for the destruction and degradation of pollutants and contaminants has been developed for ensuring a sustainable bioremediation strategy. Following proper techniques of bioremediation can result in productive and non-deleterious quality of the environment. Till now several researches are going on to find the best agent for providing best green remediation. This chapter explains the causes, processes and mechanisms used in bioremediation emphasizing efficiency of different living organisms (tools) and case studies to cleanup the environmental contaminants.

A BRIEF HISTORICAL OVERVIEW

In bioremediation, different microorganisms, fungi, algae and plant species has been extensively used to decrease, degrade, transform and detoxify the pollutants from the contaminated sites. Potential liv-

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