Chapter 67
Genetically Engineered Microorganisms for Bioremediation Processes:
GEMs for Bioremediaton

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ABSTRACT

In the past few decades, environmental pollution is a major issue which affects biodiversity public health and eco systems present in worldwide, nowadays, microbial potential are connected to effect the clean-up of environmental pollutants. Conventional methods are focus on the separation, rather than the destruction of contaminants, the use of genetically engineered microorganisms for bioremediation would be an alternative, environmentally friendly, more effectiveness and economical clean-up technique for the remediation of pollutants in present in contaminated sites. A combined strategies relationship between genetic engineered microbes and bioremediation can enhance the effectiveness of contaminants sites. Here, we have elaborated recent work on the investigation and improvement of these microbes using genetic tools and given an outlook of what may be possible in the near future.

1. INTRODUCTION

The introduction of synthetic compounds into the environment, composed with the massive removal of natural materials to distinctive environmental compartments. In some cases this accumulation can constitute a severe hazard. During the past several decades as a result of human activities, has resulted in the various elements of the chemical structures of many of these pollutants are beyond the biodegradation

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capabilities of microorganisms by existing pathways (Pieper & Reineke, 2000; Dejoinghe et al., 2000; Bruins et al., 2000). A vast number of pollutants and waste materials containing heavy metals are disposed into the environment per annum. The contaminants causing ecological problems leading to imbalance between nature and global concern. Thus, control and treatment strategies to reduce the hazardous effects of pollutants are needed. Instead, conventional physical, chemical and thermal processes have high costs; require high energy demand and consumption of many chemical reagents. The search for alternative methods for traditional methods resulted in evolution of bioremediation techniques. It approaches is cost effective, economical and alternative to conventional treatments, which generally incinerations, immobilization of the pollutants. Generally used approach to bioremediation involves multidisciplinary approach include biostimulation where organisms selected for high degradation abilities are used to inoculate the contaminated site, bioaugmentation adding microorganisms that naturally contain catabolic genes, bioaccumulation this process requires live cells, biosorption where metal sorption to cell surface by physicochemical mechanisms and phytoremediation use of plants to concentrate and metabolize toxic compounds in contaminated sites. During bioremediation, bacteria utilized for metal removal from contaminated sites is also a promising technology. However, the bacterial or plant-based processes may include the large volumes of production based on pollutant-loaded biomass, which is problematic disposal. Accordingly, in the current scenario, biological methods, i.e. bacterial mediated bioremediation, have the upper hand in terms of sustainability and easy applicability *in-situ*. The development of genetic engineering has given us the substantial knowledge of molecular biology and biochemistry has also led to the development of efficient techniques to monitor the fate of genetically engineered microorganisms (GEMs) upon release into the environment. Genetically modification technique has resulted often in a wide variety of current and promising applications for use in the process of bioremediation. Today, genetically modified microorganisms have found applications in human health, agriculture, and bioremediation and in industries such as food, paper, and textiles. Genetic engineering offers the advantages over traditional methods of increasing molecular diversity and improving chemical selectivity. GEMs have the possible to be a persuasive tool for cleaning up certain kinds of environmental contamination. This present discussion delineates several molecular tools and strategies to engineer microorganisms; the advantages and limitations of the methods are addressed. The final part of this chapter reviews and evaluates several applications of GEMs currently employed in commercial ventures.

2. BACTERIAL-RECOMBINANT DNA USED IN GEMS

2.1 Natural Horizontal Transference of DNA in Bacteria

The importance of genetic factors pivotal steps in deliberating biodegradation potentials on microorganisms. The role of plasmid DNA plays on important in genetic adaptation and bacterial genomes of microbial populations to distinguishing environmental changes are generally accepted nowadays. It represents a highly mobile form of DNA which can be transferred via conjugation or transformation. Besides, the most useful to consider horizontal transfer of recombinant DNA in the overall context of horizontal gene transfer among bacteria, for many genes (antibiotic resistance, heavy metal resistance, symbiotic and degradative), and in many environmental situations (Davison, 1999). It has been suggested that it is an important key role in contributing to the development of novel biodegradation capacities of microbial