Chapter 22
Biodegradation of Plastic
An Innovative Solution to Safe the Human Health and Environment

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ABSTRACT

The use of plastics is increasing gradually, and its degradation is becoming a great threat for society. This chapter raises a question in front of us: Ultimately, how can we balance our needs and safety? Therefore, a term biodegradation is frequently used to explain the ability of microorganism to degrade the organic substance. The chapter would deliver the importance of biodegradation of plastic products, which is a rapidly growing field and offers a new dimension solution with novel properties in waste management areas. Microorganisms like bacteria, fungi, and actinomycetes have developed a special strategy in order to use such materials as energy and carbon source. Biodegradation is the most economic, eco-friendly, and acceptable method. But the detailed characterization of efficient plastic-degrading microbes and microbial enzymes still needs to be carried out. The chapter would also provide a better understanding related to the biodegradation of plastic products that enhances the horizon of knowledge.

INTRODUCTION

Plastic is a synthetic polymer and it made up of carbon, hydrogen, oxygen, chloride, silicon, and nitrogen. The utility of plastics are increasing day by day to complete our basic needs. The uses of plastics are extensively increases because of their unique property like stability and durability which make it differ from other polymers. But due to the lack of safe disposal and efficient degradation methods of these synthetic polymers, they are gradually accumulated in the environment and posing an ecological threat to vegetation and animals (Bhardwaj et al., 2012). In this chapter we tried to explain the hazardous impacts of plastic and its biodegradation mechanism. Apart from this the chapter also deals with

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other eco-friendly techniques i.e. Bioplastic which is greatly employed in a new era. A large amount of plastic waste is being generated rapidly worldwide. Out of many countries the India, China and UK contribute 16 million tons, 4.5 million tons and 1 million tons of plastic waste, respectively (Kumar et al., 20011).Many reports stated that India produces nearby 10 thousand tons of plastic waste (Puri et al., 2013). The yearly production of plastic was estimated as 57 million tons in Europe in 2012. Plastic waste recycling has not been focused mainly therefore it create such unsuccessful outcomes; of the over 1 trillion plastic bags dumped per annum in the US, only 5% are recycled. Apparently, waste management (bioremediation) is one of the ways to reduce the adverse effects and can serve as a potential tool in plastic waste decomposition (Shah et al., 2008 b; Ojo et al., 2007 & Ali et al., 2014).Plastic waste is the origin of eight complex problems in the aquatic environment: (1) plastic debris pollutes, (2) plastic entangles marine life, (3) consumption of plastic items by marine fauna, (4) petroleum-based plastic polymers biodegradation is time-consuming, (5) broken plastic and its pellets interrupt the food web, (6) interfere the sediment populations, (7) oceanic litter destroying the primary habitat of new emerging life and (8) marine plastic litter also causes a major damage to vessels. A report on 1970s study stated that out of 247 plankton samples in the Atlantic Ocean, 62% of the samples were found as a plastic material. With such kind of challenges, scientists started their ongoing research to explore whether plastics could be designed to become susceptible to microbial attack, making them degradable in microbial lively surroundings. On the other way researcher also start to search the new application of bioremediation. Biodegradation is nature's technique of recycling wastes, or breaking down organic substance into nutrients that can be used and reused by other organisms. In the microbiological words, "biodegradation" refers to the decaying of all organic materials are carried out by an enormous variety of life forms comprising mainly bacteria, fungi, and other organisms. This proves as one of the crucial, natural, biologically mediated processes that convert the hazardous toxic chemicals into non-toxic or less toxic substances. Microorganisms are involved in the degradation and deterioration of both synthetic and natural polymers. The polymers are not directly consumed by microorganisms whereas most of the biochemical processes takes place. Increasing demand of biological degradation of organic compounds may be considered as an economical and efficient tool for remediating hazardous waste-contaminated surroundings. Whereas some environments may be too severely contaminated for initial in situ treatment to be effective, most contaminated media will use some form of biological degradation in the final treatment phase. The sorting out of wide variety of discarded plastic materials is another typical time consuming process. Another element which also develops a serious issue is related to the combustion of plastic waste. Incineration of plastic polymers causes the release of various poisonous compounds such as hydrogen cyanide into the environment. Moreover the additives like pigments, coatings, fillers etc. present in the plastic restrict the use of recycled material. In such a circumstance, biodegradable plastics offer the best solution to the environmental hazard posed by the conventional plastics. As an alternative to synthetic plastics, biodegradable polymers are a newly emerging field. Various mechanistic roles are played by the microbes according to the polymer type's help us to resolve the problem. This chapter also focuses on mechanism of action of various microorganisms that create an idea to research out other facts associated to this and open a new door for microbial application.