

Chapter 10

Biotechnology Methods for API Removal From Pharmaceutical Wastewater

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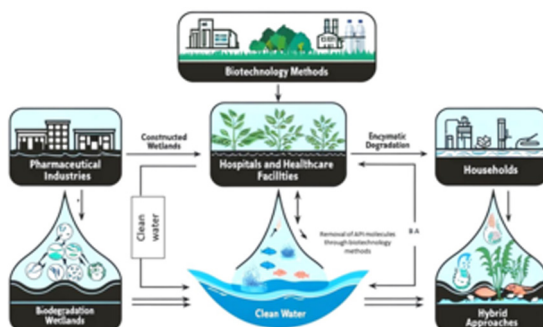
ABSTRACT

In recent decades, the use of pharmaceutical products has been increased tremendously with over thirty million tons of pharmaceuticals are consumed worldwide. Pharmacological drugs have a crucial role in preserving the health and welfare of both humans and animals. Many used pharmaceutical products are not completely metabolized in human and animal body leading to gets accumulated in rivers, lakes, and drinking water worldwide as persistent organic chemicals causing severe damage to aquatic ecosystems. This chapter analyses several biotechnology methods employed to remove APIs from pharmaceutical wastewater, specifically emphasizing biological treatments that harness the capabilities of microorganisms and enzymes. The present paper provides a thorough analysis of microbial degradation, bioaug-

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mentation, and the application of bioreactors. Furthermore, it highlights the efficacy, challenges, and potential for integration into existing treatment systems (Figure 1).

INTRODUCTION



OVERVIEW OF PHARMACEUTICAL WASTEWATER

Pharmaceuticals are defined as biologically active compounds administered to humans and animals for treating various diseases with diverse modes of actions. The rapid expansion of pharmaceutical companies can be attributed to fulfilling drug demands, which in turn has caused a considerable rise in the production of pharmaceutical wastewater (Jiang et al., 2021; Ahmad et al., 2017). The composition of this wastewater leading to elevated concentrations of chemical oxygen demand and a range of hazardous compounds (Ouyang et al., 2017; Ji et al., 2021; Eniola et al., 2022). Inefficiency of conventional methods of water treatment towards removal of pharmaceutical traces from wastewater has raised a global concern, resulting to increase pharmaceutical traces entering into the environments. The discharge of effluents containing untreated or partially treated pharmaceuticals have been documented for its detrimental effect on aquatic life. Even at traces concentration, it has potential health risk to human health. A significant number of chemicals found in pharmaceutical wastewater remain in the environment because of their chemical stability. Consequently, these compounds permeate through various environmental media, get accumulated in the food chain and contribute to long-term ecological degradation and human health hazards (Shi et al., 2017; Malik et al., 2019). Several pharmaceutical drugs found to be present in pharmaceutical wastewater along with their adverse effects are listed in Table 1 given below. Therefore, pharmaceutical wastewater has emerged as a substantial worldwide environmental and public

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