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Isolation and Identification of Polyethylene Terephthalate Degrading Bacteria from Shatt Al-Arab and Sewage Water of Basrah City

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Abstract:

Biodegradation is utilizing microorganisms to degrade materials into products that are safe for the environment, such as carbon dioxide, water, and biomass. The current study aims to isolate and characterize bacteria with polyethylene terephthalate (PET) degradation ability isolated from Shatt al-Arab water and sewage from Basra, the bacteria were identified as *Klebsiella pneumonia*. According to the findings, the isolates showed a highly significant difference in degradation of PET (24% during 7 days) and the percent of degradation increased to 46% at 4 weeks compared to the control. The study also involved determining the optimum temperature of *K. pneumonia* growth, which was 37°C, while the preferred pH was 7-8. The research revealed that PET biodegradation by *K. pneumonia* can be used as a suitable and environmentally friendly tool.

Keywords: Biodegradation, Degradation Bacteria, *Klebsiella Pneumonia*, Plastic, Polyethylene Terephthalate (PET).

Introduction:

The annual global production of synthetic polymers is about 140 million tones and, due to their exceptional stability, these polymers do not easily enter into the degradation cycles of the biosphere. The environmental pollution of synthetic polymers, such as that caused by waste plastics and water-soluble synthetic polymers in wastewater, has been acknowledged as a significant problem[1,2]. One of the most commonly used plastics is polyethylene terephthalate (PET), which contains ethylene glycol and terephthalic acid as repeating units. PET is used in the manufacture of fibers, containers, films, and bottles because of its remarkable properties such as durability, ability to be molded, and light weight[3]. The waste of PET keeps on in terrestrial and marine environments, which frequently causes harm or death to some of the organisms[4]. PET contamination is controlled via chemical, thermal, and mechanical methods. However, these techniques either produce extra pollutants or cost a lot of money; therefore, alternative methods must be found[5]. The process of a polymer's chemical structure changing from a more complex to a simpler one under the influence of several biological agents, such as bacteria, fungi, and various atmospheric microorganisms, is known as biodegradation[6]. More than 90 genera of microorganisms that break down polymers such as: *Actinomycetes, Thermoactinomyces, Azotobacter, Alcaligenes, Streptomyces, Mycobacterium, Micromonospora, Flavobacterium, Escherichia, Rhodococcus, Streptococcus, Klebsiella, Nocardia, Pseudomonas, Comamonas*, and *Staphylococcus*[7,8]. The plastic biodegradation mechanism involves many levels. Firstly, the microbial attachment changes the physical and chemical characteristics of the plastic surface, followed by enzymatic cleavage, which breaks down the large polymers into smaller molecules of oligomers and monomers (bio fragmentation). Numerous hydrolyzing enzymes, including esterase, ureases, or proteases, catalyze the dissolution of various polymer linkages. The broken polymer is embraced by bacteria through assimilation, where it is mineralized into CH_4, CO_2, and H_2O, etc[9,10]. There are several aspects that can be investigated for improved polymer plastic biodegradation, including: utilizing surface-active