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# A review on the versatility of *Carica papaya* seed: an agrogenic waste for the removal of organic, inorganic and microbial contaminants in water

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## Abstract

**The advent of civilization, coupled with growing industrialization in many countries, is placing more demand on the available water sources. At the same time, the daily surge in wastes generated by man's anthropogenic activities has led to microbial, organic and inorganic contamination of water sources. Based on available evidence, significant research efforts are being made into the use of low-cost agricultural materials such as *Carica papaya* seed (CPS) in the removal of these contaminants from water sources in a bid to provide clean water. In the present review, the organic, inorganic and microbial contaminants in waters were elucidated. Furthermore, the chemical composition of the CPS was illustrated. The adsorption capacity and efficiency of CPS and their composites in the remediation of the selected contaminants were discussed while identifying the various factors affecting the adsorption efficiency. Finally, the reusability of this agricultural material was discussed. Solution pH was identified as a major factor influencing the sorption process. The high removal efficiency reported in the studies that adopted CPS showed its vast potential in the elimination of contaminants from water sources. Also, the regenerative potential of the adsorbent over several cycles indicated its long-term use. The economic feasibility and environmental sustainability afforded by using CPS chart a path for further investigation into the use of other low-cost agricultural materials in the elimination of environmental contaminants.**



**Keywords:** adsorption; *Carica papaya* seed; heavy metals; microbes; trace organic chemicals; water

## INTRODUCTION

The universal importance of good-quality water and the continuous development of industrialization has placed tremendous pressure on water resources, which consequently results in water pollution emanating from organic, inorganic and microbial contaminants. Hence the need to treat contaminated water has become a global concern because of recent reports on the levels of these contaminants.[1] Water pollution can be defined as any alteration in the biological, chemical and physical features of water that leaves a destructive consequence on the health of humans.[2] Inorganic and organic contaminants, especially heavy metals, radionuclides, nutrients and trace organic chemicals (TrOCs), have been discharged into water bodies from different anthropogenic sources ranging from agricultural activities, leakage of leachate from landfills, and municipal and industrial effluent discharge.[3-9] TrOCs include herbicides, pharmaceuticals, antibiotics, personal care products, steroid hormones, parabens, anions, and toxins produced by bacteria. Some of these contaminants are toxic to aquatic and human life at low concentrations owing to their mutagenicity, carcinogenicity and teratogenicity.[10-13] The associated effects of these contaminants include impaired reproductive ability, disrupted endocrine system and sometimes death.[14-17]

Heavy metals, which include lead, mercury, copper, zinc, chromium, cadmium and arsenic, are non-biodegradable, which leads

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