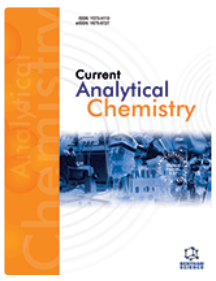

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Review Article

Emerging Technologies for Sensitive Detection of Organophosphate Pesticides: A Review

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Abstract

The use of organophosphate pesticides (OPPs) in agricultural practices improves crop yield and controls pests, but their indiscriminate use and persistence in the environment pose significant health risks. Therefore, it has become increasingly important to develop reliable and efficient detection methods for OPPs to ensure food safety and monitor their presence. In recent years, OPP detection methods have undergone significant advancements. Sensors such as colorimetric, fluorescence, electrochemical, and impedometric offer several advantages over traditional methods, such as high sensitivity, selectivity, and portability. The purpose of this review paper is to provide an overview of recent developments in OPP detection methods. The paper discusses the different types of sensors that are available for the detection of OPPs, as well as their advantages and disadvantages. Many electrochemical methods have been employed to investigate OPP detection, including voltammetry, impedance spectroscopy, and amperometry. The integration of nanomaterials, such as carbon nanotubes, graphene, and metal nanoparticles, has significantly enhanced the performance of electrochemical sensors by providing high surface area, enhanced electron transfer, and specific analyte interactions. Furthermore, the review discusses the utilization of biomolecules, such as enzymes and aptamers, as recognition elements in sensor platforms for selective and sensitive OPP detection. The incorporation of these biomolecules offers high specificity and enables real-time monitoring of OPP residues in food samples and environmental matrices. It emphasizes the importance of continued research and development to optimize detection methods, improve sensor performance, and make these technologies more widely accessible for effective monitoring and control of OPP contamination in various domains.

Keywords: Organophosphate pesticides, detection methods, colorimetric sensors, fluorescence sensors, electrochemical sensors, limits of detection, real sample analysis, differential pulse voltammetry.

Graphical Abstract