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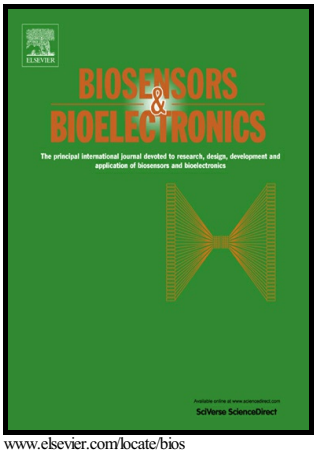

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Ultrasensitive electrochemical immuno-sensing platform based on gold nanoparticles triggering chlorpyrifos detection in fruits and vegetables

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ABSTRACT

Chlorpyrifos (chl) is an organophosphate pesticide extensively used in agriculture and highly toxic for human health. Fluorine doped tin-oxide (FTO) based electrochemical nanosensor was developed for chlorpyrifos detection with gold nanoparticles (AuNPs) and anti-chlorpyrifos antibodies (chl-Ab). AuNPs provides high electrical conductivity and specific resistivity, thus increases the sensitivity of immunoassay. High electrical conductivity of AuNPs reveals that it promotes the redox reaction for better cyclic voltammetry. Based on the intrinsic conductive properties of FTO-AuNPs complex, chl-Ab was immobilized onto AuNPs surface. Under optimized conditions, the proposed FTO based nanosensor exhibited high sensitivity and stable response for the detection of chlorpyrifos, ranging from 1 fM to 1 µM with limit of detection (LOD) up to 10 fM. The FTO-AuNPs sensor was successfully employed for the detection of chlorpyrifos in standard as well in real samples up to 10 nM for apple and cabbage, 50 nM for pomegranate. The proposed FTO-AuNPs nanosensor can be used as a quantitative tool for rapid, on-site detection of chlorpyrifos traces in real samples when miniaturized due to its excellent stability, sensitivity, and simplicity.

Keywords: Fluorine doped tin-oxide, nanosensor, chlorpyrifos, gold nanoparticles, antibodies, immunoassay

Introduction

Chlorpyrifos (O, O-diethyl-O-3, 5, 6-trichloro-2-pyridylphosphorothioate) is an organophosphate, a broad spectrum pesticide widelyused in agriculture for the prevention and control of harmful insects and mites on various field crops like fruits, vegetables, cotton, and tea etc. (Chen et al, 2015). Chlorpyrifos is one of the largest used pesticides globally and it enters the food chain and causing harmful effects in animals and humans (Suri et al, 2009). Prolonged exposure of pesticide causes chronic diseases such as cancer, reproductive disorders, neurological disorders, allergic reactions, and most importantly