

ELECTROANALYTICAL DETECTION OF IMIDACLOPRID USING STEARIC ACID-NANO TiO₂ MODIFIED GLASSY CARBON ELECTRODE

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Imidacloprid, one of the world's most widely used insecticides, has emerged as a hidden environmental threat due to its long-term persistence in ground water and soil. In addition, contamination of food with imidacloprid residues can have serious impact on both human and animal health. Hence, its detection in environmental samples is important. Among different analytical techniques, electroanalytical techniques provide a simple and cost-effective method for imidacloprid detection. In this study, a simple, novel electrochemical method based on stearic acid and TiO₂ nanoparticles was developed for the detection of imidacloprid. TiO₂ nanoparticles were synthesised using the sol-gel method and characterised by scanning electron microscopy, Fourier transform infrared spectroscopy and powder X-ray diffraction, which indicated that TiO₂ nanoparticles with an average diameter of 24.46±1.32 nm were successfully synthesised. The glassy carbon electrode (GCE) was modified with stearic acid-nano TiO₂ suspension using simple drop casting method. The electrochemical behaviour of imidacloprid at the bare GCE and at the stearic acid-nanoTiO₂ modified GCE were studied using electroanalytical techniques, namely, cyclic voltammetry (CV) and steady state amperometry. CV analysis resulted in a single reduction peak at -1.2 V, indicating the electroactivity of imidacloprid. Electrode fouling observed in amperometric studies with the bare GCE was overcome with the stearic acid coating, while the sensitivity of the electrode was enhanced by incorporating TiO₂ nanoparticles. The modified electrode developed provides an amperometric sensor to detect imidacloprid with a linear dynamic range of 1.19×10⁻⁴ mol L⁻¹ to 6.97×10⁻⁴ mol L⁻¹. It exhibited a minimum detection limit of 8.77×10⁻⁶ mol L⁻¹, which is closer in value for similar type of modified electrodes reported in literature, and a limit of quantification of 2.92×10⁻⁵ mol L⁻¹, offering a potential tool for imidacloprid detection in environmental samples.

Keywords: Amperometry, Cyclic voltammetry, Modified electrode, Nano TiO₂, Stearic acid