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ELECTROCHEMICAL INVESTIGATION OF THIAMETHOXAM ON BARE AND STEARIC ACID/SILVER PARTICLES MODIFIED GLASSY CARBON ELECTRODE

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The intensive use of pesticides contributes to environmental contamination and potential health risks, requiring the development of sensitive detection methods. Thiamethoxam (TMX) is one of the most widely used neonicotinoid pesticides in modern agriculture. Among the existing analytical detection techniques, such as high-performance liquid chromatography and gas chromatography, electrochemical methodologies offer a promising alternative, due to their cost-effectiveness and efficiency. In this research, cyclic voltammetry, square wave voltammetry, and amperometry were employed to obtain electrochemical responses under various conditions. The results revealed an irreversible reduction peak at –1.24 V vs. the Ag/AgCl/KCl reference electrode, attributed to the characteristic reduction of the nitro group to hydroxylamine derivative of TMX, occurring via a diffusion-controlled process in pH 9.0 Britton-Robinson buffer according to the peak current-scan rate relationship. Although electrochemical sensors are a more effective method, electrode fouling can occur when pesticide molecules block the active surface of the bare electrode, resulting in a lower electrochemical signal, which suggests the necessity of electrode modification. Nanomaterials exhibit different properties with specific characteristics compared with the same materials with micrometer-scale dimensions. Undesirable characteristics of nanoparticles, such as the tendency to agglomerate, high surface energy, and attractive van der Waals forces between particles, which limit applications, can be overcome using stearic acid, which functions as a capping agent to maintain the stability of nanoparticles. Silver nanoparticles act as an electrocatalyst, which enhances the rate at which the electron transfer takes place at the electrode surface. The scanning electron microscopy images revealed that the synthesised particles are in an aggregated form, with a particle size of around 127 nm. The stearic acid/silver particles modified glassy carbon electrode shows a higher current response as well as lower background noise in comparison to the bare glassy carbon electrode.

Keywords: Cyclic voltammetry, Glassy carbon electrode, Silver particles, Stearic acid, Thiamethoxam