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"Global food security and food safety:
The role of universities"

Intelligently Designed Electrochemical Platform for the Detection of Food Contaminants

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Abstract

Food safety is a challenge to human health worldwide and specifically in developing countries. Continuous monitoring of food contaminants through novel and sensitive analytical techniques is a must to ensure food safety. Among these contaminants are veterinary drugs broadly used by veterinarians to control farm animal diseases. These drugs and their metabolites are usually carried over to edible animal tissues, eventually imposing negative health effects on consumers. The European Union (EU) has established a set of maximum residual limits (MRLs) for veterinary drugs and other food contaminants. Detection of food contaminants mainly depends on separation techniques such as liquid or gas chromatography coupled with mass spectrometry or immunological interaction assays, such as enzyme-linked immunosorbent assay. Despite being sensitive and specific, all these techniques require expensive equipment and highly trained personnel, which limit their applications in developing countries with poorly equipped facilities and specialists. To overcome this, nanomaterial-based biosensors have been proposed as a rapid, sensitive, efficient and portable alternative to traditional detection techniques. In the present work, we demonstrate a novel electrochemical sensor fabrication technique for trace determination of diminazene, a veterinary drug commonly used in dairy animals and present in their milk. The MRL set by the EU for the presence of this compound in milk is 150 $\mu g\,L^{-1}$. The new sensor has been fabricated using nickel ferrite nanoparticles ($NiFe_2O_4$) modifying the carbon paste electrode (CPE), together with an ionic liquid. The modified CPE showed a synergic effect toward the oxidation of diminazene. The prepared nanoparticles were investigated and characterized using different techniques, and the described voltammetric technique was optimized and validated. Under optimal conditions, the sensor showed a sensitive response to diminazene over a wide linear range. Finally, the developed method was used to quantify traces of diminazene in milk samples.

Keywords: Carbon paste, electrochemical detection, food contaminants, nickel ferrite nanoparticles, voltammetric sensor

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