K41 Determination of Synthetic Cannabinoids AB Pinaca and AB-Fubinaca With Disposable Screen Printed Carbon Electrodes (SPCE) Modified With Nanoparticles and Enzymes

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Learning Overview: After attending this presentation, attendees will be able to explain the theory and use of amperometric electrochemical techniques with disposable modified electrodes as screening tools in forensic science and to understand their implications in the fast quantification of novel synthetic cannabinoids.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by offering a novel analytical approach that provides both qualitative and quantitative information. The proposed methodology allows the on-site testing and quantification of synthetic cannabinoids at low concentration without sample destruction and as a miniaturized detection system.

Characteristics linked to electrochemical analysis include the speed of analysis, low cost, sensitivity, miniaturization, and low volume of testing material, with all of them being quickly adapted to forensic sciences practice. Screen-Printed Carbon Electrodes (SPCEs) are optimal testing devices due to low cost and disposable character, small sample volume, and the possibility of hosting modification on its surface via nanomaterials or enzymes to act as biosensors. The electrochemical process taking place can provide qualitative and quantitative information about an analyte under scrutiny. Most known SPCEs are carbon-based ink, with the additional advantage of having a significant potential window for analyte detection and possible surface modifications. The development of nanostructures at the electrode surface increases the current process and facilitates the incorporation of enzymes via functionalization. Enzyme Nanoparticles (E/NPs/SPCEs) have been shown their electrochemical performance due to selectivity and sensitivity.

Four amperometric biosensors based in the inhibitory activity of synthetic cannabinoids on enzymes were developed. AB-Pinaca and AB-Fubinaca on Acetylcholinesterase (AChE) using Acetylthiocholine Iodide (ATI) and glucuronyl transferase enzyme Uridine Diphosphate (UDP) with serotonin as substrates showed their inhibitory effect on amperometric substrates current. SPCEs were modified with gold NPs (AuNPs) for AChE and Multi-Wall Carbon Nanotubes MWCNT) for UDP. Enzymes were immobilized with carbodiimide and glutaraldehyde, respectively, and experimental optimization conditions were assessed. Michaelis-Menten apparent constants (KMapps) of biosensors were estimated in the presence and absence of inhibitors. Increasing slopes of calibration curves and values of KMapps indicate inhibitory effect at low concentration. Biosensors showed Limit of Detection (LOD) (8.4-13.0)$\times 10^{-5}$ M; Limit of Quantitation (LOQ) (2.9-4.3)$\times 10^{-4}$ M; Relative Standard Deviation (RSD) repeatability slopes (3.4–8.2)%; RSD reproducibility slopes (3.6–9.7)%, and recovery (96.8–99.6)%. This is the first time that biosensors based on the inhibitory effect of synthetic cannabinoids on these enzymes have been applied to quantitative determination.

AB Pinaca Fubinaca, Disposable Electrodes, Enzymes Nanoparticles

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