First PEDOT NPs based electrochemical MIPs sensor for the sensitive determination of Milrinone

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Molecularly imprinted electrochemical sensors have been generated with the use of molecularly imprinted polymers (MIPs) in electrochemical sensors, which provide several advantages in terms of specific target analyte recognition, sensitivity and selectivity, high chemical/mechanical stability, easy preparation, miniaturization, and reusability in the electrochemical analysis [1,2]. Since cardiovascular diseases are one of the most common causes of death in the world, their treatment is very important. Phosphodiesterase 3 inhibitors from the inotropic agent class are frequently used in the treatment of these diseases, which generally develop due to congestive heart failure. Milrinone (MIL) is commonly used in treatments as an inhibitor of the phosphodiesterase-3 enzyme. However, adverse reactions with PDE inhibitors might include increased liver enzymes, thrombocytopenia, and electrolyte abnormalities [3]. In this work, a new sensitive electrochemical sensor has been developed by electropolymerization of molecularly imprinted polymer with poly(3,4-ethylenedioxythiophene) nanoparticles (PEDOTNPs) on a glassy carbon electrode (GCE) in aqueous solution using cyclic voltammetry (CV) in the presence of Milrinone (MIL) as template molecules. Surface morphology and electrochemical characterization of MIP/PEDOTNPs/GCE were characterized by electrochemical impedance spectroscopy and cyclic voltammetry, respectively. 5 mM *o*-Phenylene diamine, (*o*-pDE) and 0.1 mM MIL was prepared in acetate buffer solution (ABS, 0.1 M, pH 5.2) and electrochemical polymerization utilized on GCE. Polymerization was performed with 30 numbers of CV scans between 0.0 V and +0.8 V at 50 mV/s. To remove unbound monomers or MIL, GCE/MIP washed with an ethanol/water mixture. The same polymerization method was then used to form non-printed polymer (NIP), that is, without MIL molecules. All electrochemical analysis of the designed molecularly imprinted electrochemical sensor were completed with CV and DPV using 5 mM $[Fe(CN)_6]^{3-/4-}$ solution in 0.1 M KCl solution as a redox probe. The electrochemical behaviour of MIP/PEDOTNPs/GCE with MIL revealed that, in comparison to bare GCE, the signal of MIL's oxidation current obtained with MIP/PEDOTNPs/GCE was much higher. This indicates that the modified electrode has excellent selectivity for MIL and may accelerate electron transport. Under optimal conditions, MIP/PEDOTNPs/GCE showed a good linear relationship between 10-100 fM and MIL oxidation peak current and MIL concentrations and limit of detection (LOD) 2.77 fM (S/N=3). The modified electrode had great repeatability and stability. Finally, MIP/PEDOTNPs/GCE has been effectively used to determine MIL in serum samples and ampoule dosage forms.

References

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