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Electrochemical Detection of the Chemotherapy Agent Methotrexate in vitro from Physiological Fluids Using Functionalized Carbon Nanotube past Electrodes

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Abstract : A simple, cost-effective, reusable and reagent-free electrochemical biosensor is developed with functionalized multiwall carbon nanotube paste electrode (f-CNTPE) for the sensitive and selective determination of the important chemotherapeutic drug methotrexate (MTX), which is widely used for the treatment of various cancer and autoimmune diseases. The electrochemical response of the fabricated electrode towards the detection of MTX is examined by cyclic voltammetry (CV), differential pulse voltammetry (DPV) and square wave voltammetry (SWV). CV studies have shown that f-CNTPE electrode system exhibited an excellent electrocatalytic activity towards the oxidation of MTX in phosphate buffer (0.2 M) compared with a conventional carbon paste electrode (CPE). The oxidation peak current is enhanced by nearly two times in magnitude. Applying the DPV method under optimized conditions, a linear calibration plot is achieved over a wide range of concentration from 4.0×10^{-7} M to 5.5×10^{-6} M with the detection limit 1.6×10^{-7} M. further, by applying the SWV method a parabolic calibration plot was achieved starting from a very low concentration of 1.0×10^{-8} M, and the sensor could detect as low as 2.9×10^{-9} M MTX in 10 s and 10 nM were detected in steady state current-time analysis. The f-CNTPE shows very good selectivity towards the specific recognition of MTX in the presence of important biological interference. The electrochemical biosensor detects MTX in-vitro directly from pharmaceutical sample, undiluted urine and human blood serum samples at a concentration range 5.0×10^{-7} M with good recovery limits.

Keywords : amperometry, electrochemical detection, human blood serum, methotrexate, MWCNT, SWV
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