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Simultaneous co-immobilization of three enzymes onto a modified glassy carbon electrode to fabricate a high-performance amperometric biosensor for determination of total cholesterol

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Abstract

In this work, we have fabricated a novel amperometric cholesterol (CHO) biosensor because of the importance of determination of CHO levels in blood which is an important parameter for diagnosis and prevention of disease. To achieve this goal, cholesterol oxidase, cholesterol esterase and horseradish peroxidase were simultaneously co-immobilized onto a glassy carbon electrode (GCE) modified with gold nanoparticles/chitin-ionic liquid/poly(3,4-ethylenedioxyppyrole)/graphene-multiwalled carbon nanotubes-1,1'-ferrocenedicarboxylic acid-ionic liquid. Modifications applied to the bare GCE were characterized by cyclic voltammetry, electrochemical impedance spectroscopy and scanning electron microscopy. The biosensor detected CHO in linear ranges of 0.1-25 μM and 25-950 μM with a detection limit of 0.07 μM . The sensitivity of the biosensor was estimated to be 6.6 $\mu\text{A } \mu\text{M}^{-1} \text{ cm}^{-2}$, its response time was less than 5 s and Michaelis-Menten constant was calculated to be 0.12 μM . Results obtained in this study revealed that the biosensor was selective, sensitive, stable, repeatable and reproducible. Finally, the biosensor was successfully applied to the determination of CHO levels in rats plasma.

Keywords: Cholesterol; Biosensor; Rats plasma.

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