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A single step electrochemical integration of gold nanoparticles, cholesterol oxidase, cholesterol esterase and mediator with polypyrrole films for fabrication of free and total cholesterol nanobiosensors

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Abstract

The development of free and total cholesterol nanobiosensors based on a single step electrochemical integration of gold nanoparticles (AuNPs), cholesterol oxidase (COx), cholesterol esterase (CE) and a mediator with polypyrrole (PPy) films is described. The incorporation of the various components in the PPy films was confirmed by chronopotentiometry, cyclic voltammetry (CV), scanning electron microscopy, energy dispersive X-ray analysis (SEM-EDX), and Fourier transformed infrared (FTIR) spectroscopy. The free cholesterol, PPy-NO_3^--$Fe(CN)_6^{4-}$-AuNPs-COx, nanobiosensor achieved a minimum detectable concentration of 5 μM, a linear concentration range of 5-25 μM and a sensitivity of 1.6 μA cm^{-2} μM^{-1} in 0.05 M phosphate buffer (pH 7.00). For the total cholesterol, PPy-NO_3^--$Fe(CN)_6^{4-}$-AuNPs-COx-CE, nanobiosensor which also involved the co-incorporation of cholesterol esterase (CE) with the other components, the achieved performances include a minimum detectable total cholesterol concentration of 25 μM, a broader linear concentration range of 25-170 μM and a lower sensitivity of 0.1 μA μM^{-1} cm^{-2}. Owing to its high selectivity, the presence of common interferants did not affect the total cholesterol measurement with the PPy-NO_3^--