DNA electrochemical biosensor based on iron oxide/nanocellulose crystalline composite modified screen-printed carbon electrode for detection of Mycobacterium tuberculosis

ABSTRACT

Death from tuberculosis has resulted in an increased need for early detection to prevent a tuberculosis (TB) epidemic, especially in closed and crowded populations. Herein, a sensitive electrochemical DNA biosensor based on functionalized iron oxide with mercaptopropionic acid (MPA-Fe3O4) nanoparticle and nanocellulose crystalline functionalized cetyl trimethyl ammonium bromide (NCC/CTAB) has been fabricated for the detection of Mycobacterium tuberculosis (MTB). In this study, a simple drop cast method was applied to deposit solution of MPA-Fe3O4/NCC/CTAB onto the surface of the screen-printed carbon electrode (SPCE). Then, a specific sequence of MTB DNA probe was immobilized onto a modified SPCE surface by using the 1-ethyl-3-(3-dimethylaminopropyl) carbodiimide/N-hydroxysuccinimide (EDC/NHS) coupling mechanism. For better signal amplification and electrochemical response, ruthenium bipyridyl Ru(bpy)32+ was assigned as labels of hybridization followed by the characteristic test using differential pulse voltammetry (DPV). The results of this biosensor enable the detection of target DNA until a concentration as low as 7.96 × 10−13 M with a wide detection range from 1.0 × 10−6 to 1.0 × 10−12 M. In addition, the developed biosensor has shown a differentiation between positive and negative MTB samples in real sampel analysis.

Keyword: Mycobacterium tuberculosis; Iron oxide; Nanocellulose crystalline; Cetyl trimethylammonium bromide; DNA biosensor