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Biosensors for biomarkers detection

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Statement of the Problem: Cardiovascular diseases are the leading cause of death in the world due to ischemic complications including heart disease and stroke. C-Reactive Protein (CRP) is a biomarker inversely correlated with cardiovascular risk. In this work, we study the electrochemical properties of protein layer grafted on gold electrode for C-reactive protein detection.

Methodology & Theoretical Orientation: Two CRP-Antibody immobilization methods were used. The first method is based on direct physisorption of CRP-Antibody onto the gold surface. The second method is based on oriented CRP-antibody with protein G intermediate layer. The two developed immunosensors were tested against CRP antigen in phosphate buffer saline solution and in human plasma. The electrochemical characterization of each immobilized layers was achieved by cyclic voltammetry and impedance spectroscopy. The morphology of the deposited biomolecules was observed by Atomic Force Microscopy and the roughness was measured. Moreover, contact angle measurement was used for wettability studies.

Findings: The response of the developed immunosensors was reproducible, rapid and highly stable. A detection limit of 100 fg/mL and 10 pg/mL antigen was observed with and without protein G respectively.

Conclusion & Significance: The developed immunosensors were successfully used for CRP detection in human plasma and the results were compared to ELISA technique. The developed immunosensor was more sensitive than the commercially available ELISA assays (CRP) with a detection limit of 2 µg/mL in blood serum. The main advantage of the impedance-based CRP immunosensor is the speed of analysis compared to a typical ELISA that needs about 4-5 hours incubation time. This speed advantage is useful for analysis in emergency cases.

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