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# Electrochemical Biosensors for Point-of-care Applications

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**ABSTRACT**

Biosensor refers to powerful and innovative analytical tool involving biological sensing element and transducer with broad range of applications, such as diagnosis, drug discovery, biomedicine, food safety and processing, environmental monitoring, security and defense. Recent advances in the field of biotechnology, microelectronics, and nanotechnology have improved the development of biosensors. Glucometers utilizing the electrochemical determination of oxygen or hydrogen peroxide employing immobilised glucose oxidase electrode seeded the discovery and development of biosensors. Molecular recognition based on geometry and forces of interaction play an important role in the biosensor development. The advent of nanotechnology led to highly efficient and sensitive biosensors. They also provide an effective immobilisation matrix for the various bioreceptors. Enzymatic and their mimetic (metalloporphyrin)-based biosensors for reactive oxygen, nitrogen species and cytochrome *c* will also be discussed. The role of antibodies and their applications in immunosensors development for cytochrome *c* and superoxide dismutase will be highlighted. The electrochemical biosensors are less expensive, miniaturised and used for point-of-care applications. Further, the fabrication of labVIEW based virtual biosensor instrumentation and microcontroller based portable biosensor for wide variety of applications also devices will be presented.

**Keywords:** Superoxide dismutase; Cytochrome *c*; Polypyrrole; Nitrate Reductase; Simultaneous determination; Nanoparticles; Biosensors; Point-of-care

## 1. INTRODUCTION

This review is an attempt to describe the recent advancements in biosensing technology for point-of-care applications. A biosensor is an analytical tool used to find analytes, It consists of three parts: (i) the bioreceptor, (ii) the transducer or the detector portion, and (iii) the reader. A biomolecule that recognizes the target analyte is a bioreceptor or biorecognition element[1]. The biomarker serves as predictor of a regular biological pathogenic process. A biomarker indicates a clear physical trait or a biologically induced observable improvement in the body that is related to a particular disease or health condition. Consequently, quantification of various biomarkers can be great importance in the therapeutic research and clinical diagnosis.

To estimate biomarker proteins various existing techniques such as enzyme-linked immunosorbent assays (ELISA), Western blot, high performance liquid chromatography (HPLC), flow cytometry and spectrophotometry were used. Due to longer analysis time, expensive tools and the expertise needed for operation, the implementation of these techniques at POC application is limited. Hence notable efforts are being made to overcome these challenges, to develop electrochemical biosensing technologies for quick, precise, sensitive and selective finding of biomarker proteins. So, we have reviewed here the point-of-care biosensors for various diseases, especially hypoxia, oxidative stress and apoptosis biomarkers proteins. Also, the design and fabrication of virtual biosensor instrumentation and microcontroller based portable and cost effective biosensor devices will be reviewed. Such biosensors that would be of interest to biologist and therapists to obtain informatics required in real time to assess the development of diseases progression, therapeutics and also applications for POC.

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## 2. ENZYMATIC BIOSENSOR FOR CYT C

Cyt c is a significant biomarker of apoptosis. The identification of cyt c release is therefore critically significant as this not only offers useful information about the existence and nature of apoptosis but also act as a preclinical marker of various pathologies, therapeutic treatment and medical diagnostics. The apoptosis/mitochondrial and DNA damage have been implicated in disease that are connected to oxidative stress and hypoxia[2]. This Cyt c used to measure cell death in hypoxia/oxidative stress. Cyt c present in an oxidized (ferric) or reduced (ferrous) form. However the structures of the two kinds of cyt c are identical, the difference in oxidation states does make major difference in binding and biochemical properties. Cyt c oxidase (CcO) based cyt c