



Review article

Biosensors: A novel approach to and recent discovery in detection of cytokines



Ahmad Mobed^{a,b,c,*}, Seyed Kazem Shakouri^{a,c}, Sanam Dolati^c

^a Aging Research Institute, Faculty of Medicine, Tabriz University of Medical Sciences, Iran

^b Neuroscience Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

^c Physical Medicine and Rehabilitation Research Center, Aging Research Institute, Tabriz University of Medical Sciences, Tabriz, Iran

ARTICLE INFO

Keywords:

Bioassay

Nanoparticles

Cytokine

Medical diagnosis

ABSTRACT

Cytokines in tissues and physiological fluids can function as potentially suitable biomarkers. Cytokines are involved in stimulating different body responses including inflammatory response to external pathogens, regulating cell-to-cell communication, and maintaining tissue homeostasis. Consequently, cytokines are extensively used to monitor and predict disease progression and to track the outcome of patient treatment. The critical diagnosis of cytokine and chemokine biomarkers has been the focus of attention and it has been continuously directing the trajectory of related research to developing a novel sensing platform. Given the major challenges and constraints of the older identification methods including their high costs, low sensitivity, and high specificity, the development of biosensor technology as a simple and inexpensive tool with high sensitivity is quite attractive and interesting. The fundamental aim of this study is to present the state-of-the-art biosensor systems in order to detect different types of cytokines and to emphasize the role of these systems in the prevention, monitoring, and treatment of various cytokine-associated diseases.

1. Introduction

Altered physiological states and illness can result from disturbance in the biomarker serum level of organisms. Reliable and rapid identification and measurement of variations in the mentioned level can facilitate the diagnosis of a disease in a timely manner. In most cases, diagnosis of chronic diseases is often a time-consuming and difficult task [1]. Cytokines are one of the most important and soluble proteins and strongly associated with the immune system including modulation of immune reactions. Cytokines are secreted by various cells including non-immune and immune cells and are fundamental indicators of the body functions [2,3]. In addition, cytokines play a number of important roles in repairing chemically induced tissue damage, controlling cell replication, inhibiting cancer progression and apoptosis, and other physiological roles [4,5]. Cell-to-cell communication can be measured and cell function can be monitored quantitatively using cytokine secretions, which are of significant value to medicine and biology. The properties of cytokines are very effective due to their active involvement in numerous downstream amplification processes [6,7]. However, only the low concentration of cytokines could be adequate to induce an important cellular response [8]. Numerous methods have been verifiably employed to measure and detect cytokines as valuable

biomarkers in different diseases [9,10]. For instance, Radio-immunoassay (RIA) [11], Enzyme-Linked Immunosorbent Assay (ELISA) [12], bioassay [13], Surface Plasmon Resonance (SPR) [14], and other methods [15] are commonly used in the related domain. Although most of these methods are precise and offer fast screening with various analytic techniques, they are constrained by high costs and the need for an expert experienced in using and applying the above technique. To solve these problems, highly sensitive biosensors have been developed to detect specific cytokines. These biosensors provide a fast and reliable medical diagnosis [16]. In this review, we present an overview of newly developed biosensor systems that detect different types of cytokines and use these systems to prevent, monitor, and treat diseases.

2. Biosensors technology

To overcome the aforementioned constraints and satisfy the requirements of medical devices such as high sensitivity, linear response, low cost, and particularly a Limit of Detection (LOD), researchers have proposed several approaches to detecting cytokines in biological and physiological samples. In this respect, a sensitive and selective biosensor that can quantify cytokines in complex matrices of physiological

* Corresponding author at: Aging Research Institute, Faculty of Medicine, Tabriz University of Medical Sciences, Iran.

E-mail address: Mobeda@tbzmed.ac.ir (A. Mobed).

<https://doi.org/10.1016/j.cyto.2020.155272>

Received 4 August 2020; Accepted 31 August 2020

Available online 08 September 2020

1043-4666/ © 2020 Elsevier Ltd. All rights reserved.

Cytokine, 136 (2020) 155272. doi:10.1016/j.cyto.2020.155272

Cytokine, 136 (2020) 155272. doi:10.1016/j.cyto.2020.155272

Cytokine, 136 (2020) 155272. doi:10.1016/j.cyto.2020.155272

Cytokine, 136 (2020) 155272. doi:10.1016/j.cyto.2020.155272

Cytokine, 136 (2020) 155272. doi:10.1016/j.cyto.2020.155272

Cytokine, 136 (2020) 155272. doi:10.1016/j.cyto.2020.155272

Cytokine, 136 (2020) 155272. doi:10.1016/j.cyto.2020.155272