

Biosensors: Applications in Disease Diagnostics

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Editorial

Humankind has faced against different kinds of diseases since the dawn of time. A wide range of methods and technologies have been developed in order to reach a correct diagnosis, which is essential to achieve an effective treatment and control of outbreaks [1]. Although symptom-based diagnosis has been the most practiced in time, it is subjective and often performs a late detection [2]. Modern society demands yet faster and more reliable diagnostic information therefore in response to this need, biological sensing of pathogenic agents such as the one that performs a biosensor has been developed in the last decades [3, 4]. Biosensors are analytical devices comprised of a biological recognition element and a transducer [5] (Figure 1).

antibodies, enzymes, DNA, and cells [7]. On the other hand, to translate the biological behavior, which can occur at a small and fast scale to a signal that could be measured and characterized, the transducers are needed. In particular, they transform the reaction result in something that could be measured with lab equipment such as colorimetry or fluoresce change of a substance in proportion to a specific analyte [8], or modify properties like the electric impedance [9].

With the use of transducers to get new interpretations to the information given to us by the biological world, it is also possible to group some sensing techniques. An example of them is the colorimetric sensing techniques, that are those in which the outcome of a biological reaction or behavior is transduced in a variation of color, this could be either on the visible or invisible spectrum of light, such examples include the modification of bacteria to make them fluorescent [10], or use chemical reactions that generate a difference in color proportional to an enzyme activity [8,11]. Enzyme sensors complies another group. The basis of enzyme sensors is the use of enzymes as the biological recognition element. The vast majority of enzyme sensors uses an electrode as the transducer and employs a type of enzymes, normally oxidoreductases or peroxidases, to perform the chemical reactions that will be measured [12]. Enzyme-based sensors have been extensively studied because of the ease of isolation and purification of the enzymes from different sources but enzyme stability and the ability to maintain enzyme activity for a long period of time are still an obstacle [6].

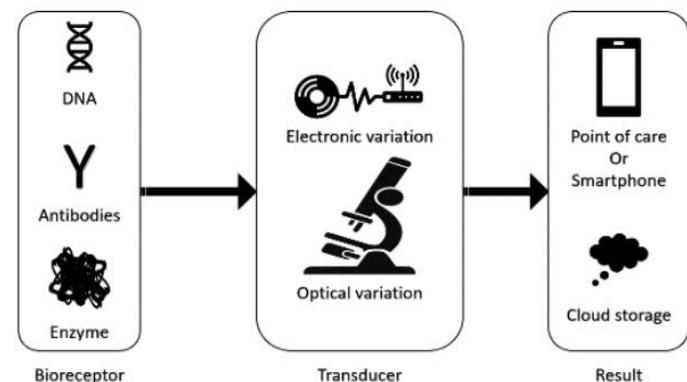


Figure 1: Biosensors Principal Components.

Emulating the responses of living biological systems, using different kind of bioreceptors and converting them in visible or electrical signals, allows biosensors to have multiple applications. Its main fields of operations are not only related to the diagnosis and control of diseases, also within the sectors of agriculture, food safety, homeland security, and environmental monitoring [6]. Furthermore, they can be classified either by their bioreceptor or their transducer type. Some examples of common bioreceptors are

Biosensor applications in disease diagnostics have been common practices for many years [11]. Its advantages are a high selectivity and sensitivity, potential for miniaturization and portability, low cost, detection in real time, use of small sample volumes and rapid response. One of the most widespread is the use of glucose oxidase enzyme, and peroxidase to create a shift in color relative to the level of glucose in the sample. This technique is used in the glucometer and is used to aid the diagnosis and continuous control of the diabetes disease [5]. Likewise, the development of

methods that can facilitate low-cost diagnosis of infectious diseases has been widely studied especially in neglected diseases such as Chagas disease.

Within the main biosensors of diagnosis of Chagas disease at the chronic state, can be found the immunosensors for serological diagnosis. During this phase, the infected subjects develop antibodies against the parasite, while immobilized antigens sometimes coupled with microfluidic systems and electrodes; allow asserting the existence of the disease [13,14]. Yet, only a few studies have focused on the acute state of the disease. Because there is no reported presence of antibodies in the body at this stage, the biosensors developed need to assert the presence of the parasite directly from a sample of blood. Some works suggest that after a proper separation of the parasite from the blood particles, employing a microfluidic system, is possible to detect the presence of the parasite with an impedance biosensor which could generate a characteristic response for each particle type in the sample, among them, the parasite.

Another approach in the use of biological behaviors to detect the presence of diseases is taking advantage of the antibodies, which are used by the immune system and bind themselves to bacteria or viruses [15]. An example of this approach is the use of antibodies immobilized on gold as biosensors to detect the presence of the Human Papilloma Virus (HPV). The change of impedance of wells with gold electrodes are measured, where the monoclonal antibody (mAb)5051 was immobilized. Those variations are due to the existence of the HPV in the sample, which bind to the antibodies and change the impedance of the system [9].

The prospects of diagnostic biosensors are promising. Although the rate of growth of the biosensors market still has to reach that of its state of the art in the Academy, they are expected to be faster, easy to manufacture and use for untrained individuals, which will allow them to reach a wide percentage of the people affected by these diseases. To achieve an ideal scenario where every smartphone is transformed in a complete lab on a chip with disease diagnostics capabilities, the study and use of biosensors is crucial. Generation of developments in this area and their continuous publication will allow these advances to be adequately given and hopefully Biosensors and Bioelectronics Open Access will publish many of these findings.

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