Short Communication
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Biosensors for Agri-food Applications: Advantages and Limitations

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Short Communication

Biosensors are developed and used to detect the biological analyte and produce a measurable output signal. Biosensors consist of a detector and one reporter. The detector must have high specificity and sensitivity to detect analyte with greater accuracy and measure its quantity with precision and reproducibility. Additionally, the biosensors need to be robust to be able to function under different conditions of pH, redox states, temperatures and spatiotemporal variations. Since biosensors detect the biological analyte, ideally it should be non-toxic and should not interfere with the physiology or biochemistry of the in vitro or in vivo substrate.

There are two types of biosensors, one is the direct biosensor and the other one is the indirect biosensor. Typically, the direct biosensors detect the protein activity after binding with the ligand. Indirect biosensors contain two domains, one serves as a ligand receptor and the other one detects the structural changes after binding with the ligand and produces a measurable output. Direct biosensors are used for the determination of the ions in the substrate and measure them by means of the fluorescence intensity. Direct biosensors are used for the detection of the pH, redox state, ion concentration, metabolite concentration in the living plant cells. For example the auxin detection degradation biosensors are used whereby the biosensor undergoes degradation as a result of the analyte binding. Indirect biosensors are used for the detection of the enzymes [1].

Several agrochemicals are being used for soil fertilization, insect pest removal, pathogens, parasites, weed management and their excessive usage causes environmental problems. The analysis of these chemicals in the natural ecosystem requires sophisticated equipment and reagents and the samples need to be transported. Such analysis requires trained personnel and therefore the use of the biosensors is more preferable as they are portable and cost effective and provides the results in very short duration [2]. The electrochemical and optical transducers are preferable for such measurements. Microbial biosensors are also being used as they are diverse in their genetic constitution, adaptable to different conditions, amenable for genetic transformations and cost effective in culturing and maintenance [3].

Various optical detection methods include colorimetry, fluorescence measurements, surface Plasmon resonance and surface enhanced Raman spectroscopy. The introduction of the nanomaterial's significantly enhanced the detection precision and portability. Integration of communication technology such as smartphone devices also enhances the speed of data transfer and resolution. A large number of electrochemical sensors were developed for the detection of the small molecules, proteins, microorganisms, for ensuring the safety of food and drink consumption [4]. They function on various principles including the redox processes for the recognition of the antibodies, enzymes, aptamers and function as fast sensitive and low cost platforms for food industry. Such technologies are immensely useful for the food industry, food policy makers, and the end users or consumers [5].

The uses of nanotechnology based sensors are also on the rise for agri-food applications. For the detection of the allergens, toxins and other biological pathogens certain electrochemical sensors are used. This will ensure safety and quality of the consumption and preservation of the food.

Biosensors represent the emerging applications in the field of synthetic biology. Technological advances in the DNA synthesis and manipulation had given hope of developing biosensors for wider applications [6]. These biosensors increase the screening throughput and the evaluation of large samples in short duration of time. New designs of the biosensors are being tested for future applications. However, the development and fabrication of the biosensors can be very challenging based on the degree of gene and protein engineering that is required to be done and the configuration that is required to obtain the desired functions. In future the biosensors will find applications in the industrial, environmental, scientific and medical fields.

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