Biosensors: A Potential Component in Agriculture and Food Safety

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ABSTRACT

In agriculture, biosensors are vital tools because they enable prompt and accurate identification of infections, contaminants, and fraudulent food. They are composed of a biological sensing element and a transducer for the detection of analyte concentration. Many biosensors are available for biorecognition components, including aptamers, enzymes, nucleic acids, and antibodies. Among the many uses of biosensors in agriculture are the direct identification of plant pathogens, early disease detection, soil chemistry, air organophosphorus concentrations, pesticides, plant nitrate status, and foodborne pathogens. Biosensors can be an important addition to the components which helps in achieving sustainable agriculture practices.

INTRODUCTION

The sector of agriculture is improving rapidly by the grace of a wide range of technical and scientific developmental works which is represented by an array of tools and methods. Every day science finds its way to amaze people by means of different innovations and facts. One of such amazing factors of science is biosensor. By the name itself biosensor says that it is related to biological science.

A biosensor refers to an analytical tool that measures signals derived from biological reactions by converting into some measurable

signals like electrical signals that are proportionate to the concentration of an analyte. Two components make up a conventional biosensor: a transducer for analyte concentration detection and a biological sensing element (Arora, 2013).

To put it briefly, biosensors are essential for quick and precise detection in a variety of settings, such as quality control, environmental monitoring, and medical diagnostics. Different types of biosensors are available today, based on the transducers they use (Boro *et al*., 2023).

Different types of biosensors:

According to Griesche and Baeumner (2020), The most extensively studied biosensors included enzymes, aptamers, nucleic acids, and antibodies as biorecognition components to identify contaminants, food fraud, and pathogens. They have described different biosensors as follows.

Antibodies: In immunoassays, antibodies are a frequently utilized recognition element that facilitate the particular binding that separates the analyte of interest from the sample matrix. Since other recognition components have not been able to match the substantial binding constants of antibodies, they are indispensable in both the creation of new sensitive detection procedures and many well-established assays (Griesche and Baeumner, 2020).

Aptamers: As a biorecognition element, aptamers are a well-known substitute for antibodies that have gained popularity in the field of science during the 2000s. The reason for the increasing attention is that they are cheaper to synthesise than antibodies because to their great batch-to-batch repeatability and lack of reliance upon animals or cells during manufacturing. In addition, aptamers have a long shelf life, remain stable in non-physiological environments, and may be readily altered to enhance their performance (Griesche and Baeumner, 2020).

Nucleic acid: In conventional DNA hybridization experiments, nucleic acids are frequently employed as particular biorecognition elements. In the required sensitive detection of species of bacteria, fungi, viruses, or other agricultural pathogens, or in the detection of alien species in the event of food fraud After DNA amplification, experiments using DNA hybridization rather than sensors are more prevalent (Griesche and Baeumner, 2020).

Enzymes: In immunoassays, enzymes are frequently utilized as labels to catalyze chemical processes that produce colorful or electrochemically active marker molecules or fluorescent dyes. Enzymes can also be used as components of biorecognition (Griesche and Baeumner, 2020).

Bacteriophages: By specifically attaching to receptors, bacteria-infecting viruses known as bacteriophages can be employed as a biorecognition element enabling the identification of bacterial cells. A characteristic that is sometimes lacking in antibody-based assays, bacteriophages have a high selectivity regarding the bacterial target and the ability to differentiate between living and dead bacterial cells (Griesche and Baeumner, 2020).

Application of biosensors in agriculture:

As reviewed by Boro *et al.* (2023), there are several uses of biosensors in agriculture which includes-

1. Direct detection of plant pathogens
2. Early detection of disease onset in field
3. Helps in understanding the chemistry of soil its important properties
4. Detection of rising atmospheric concentrations of organophosphorus

5. Detection of pesticides along with their residues in the plants and environment

6. Measurement of plant nitrate status

7. Identifying mycotoxins as well as food borne pathogens.

CONCLUSION:

As the era of science and technology is rising very high, it has led to several essential improvements in different sectors of agriculture and integration of biosensor is one of such important steps which has been transformative for the new age farming. Biosensor can provide several advantages if used properly in different detection systems regarding agriculture. It can be an important add on to sustainable agriculture practices which can revolutionized the whole farming system. It holds potential for improving the overall farming and production system if utilized economically.

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