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A brief Review on the Nano-biosensors in the Agriculture Area

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ABSTRACT- Nanotechnology emerged as gift to mankind, with great potential in a broad variety of areas of research and our everyday life. In contrast to conventional biosensors, the application of nanotechnology in the creation of biosensors results in a highly effective nano-biosensor with a tiny shape. Nano- and Nano sensors based keen delivery systems can be used to monitor the release of agrochemicals for pest and pathogen defense, to detect the presence of plant viruses, to determine soil nutrient content, and to release nano-encapsulated slow-release fertilizers without wasting them by leaching. As a consequence, there is a lot of optimism that such robots may assist maintain agriculture by boosting output and productivity. Nanotechnology has emerged as a gift to mankind, with great potential in a broad variety of areas of research and in our everyday lives. As nanotechnology is utilized to improve biosensors, it results in a more resilient nano-biosensor with a smaller structure than conventional biosensors. Nano-biosensors may detect wide variety of fertilizers, herbicides, pesticides, insecticides, bacteria, moisture, and soil pH, among other things. When utilized correctly and in a controlled way, nano-biosensors may assist to promote sustainable agriculture and improve crop production.

KEYWORDS- Agriculture, Biosensors, Herbicides, Nano-biosensors, Nanotechnology.

I. INTRODUCTION

Agriculture's access to total water and land resources is the rapidly decreasing, resulting in significant losses in the agricultural output [1]. Furthermore, increasing amounts of pesticides, herbicide and metal in the agricultural lands are worrisome [2]. This issues only successfully handled with help of developing technology and a continuous inflow of new technologies in to this industry. Nanotechnology is presently regarded as fast developing fields with great promise to change food and agricultural systems [3].

A nano-biosensor is modified form of biosensors, which is define as a tiny logical system or unit containing biologically or biological resulting sensitized agent and physico-chemical transducers [4]. The 1st biosensor was developed in 1967, which is to developments of the numerous other biosensor. Biosensors have been available since the early twentieth century, but their uses were confined to labs [5].

As technology advanced, numerous novel biosensors were created [6]. There are three so-called "generations of bio-medicinal sensors; electricity biosensors operated in the first generation; biosensor functions in the latter generation involving specific "mediators" between the reaction and transducer in order to generate an improved response; and the reaction itself in third generation biosensors does not directly affect product or mediator diffusion [7].

Nano-biosensors with excellently devoted tiny sensors with extremely miniaturized were developed and constructed in the twenty-first century based on nanotechnology concepts. Researchers have recently created biosensors with unprecedented spatial and temporal accuracy and endurance by combining nano-sciences, electronics, computers, and biology [8].

Nano-biosensors are nanosensors comprising immobilized bioreceptor probes that are selective for target analyte molecules. A nano-biosensor is typically constructed at the nanoscale to collect, store, and analyze data at the atomic level. Nano-biosensors offer up new opportunities for scientific study and give resources for real-world bio-analytical applications that were before unattainable. They may be used in conjunction with other technologies, such as lab-on-a-chip, to make molecular research easier. Their applications include the identification of analytes such as urea, glucose, toxins, and other substances, as well as the control of metabolites and the detection of different bacteria and pathogens [9]. Features of an Ideal Nano-biosensor:

- Highly specialized for the aim of the analysis i.e., a sensor must be able to differentiate [10].
- Highly sensitive for the aim of the measurements, i.e., a sensor must be able to distinguish between analytic and some “other” material [11].
- Some physical factors like as stirring, pH, and temperature should have no impact on the particular interaction between analyses [12].
- Reaction time should be reduced to a bare minimum [13].
- The findings should be trustworthy, accurate, reproducible, and linear across the relevant empirical spectrum, as well as devoid of electrical noise [14].
- The Nano-biosensor must be very tiny, biocompatible, nontoxic, and antigenic [15].
- It should be cheap, small, and appropriate for semi-skilled workers.

The transducer act as interface to measure and convert physical transition that occurs in the biological response reaction into a measurable electric production [16]. The transducer may be classified into the following categories and studied in detail, based on the method of operation (Table 1). The detector element captures the transducer's signals, which are then amplified and analyzed by a CPU [17]. As shown in Figure 1, a typical nano-biosensor consists of three components: physiologically sensitized elements (probe), transducer, and detector [18].

Table 1: The Principle and Applications of Various Transducer Systems.

S. No	Transducer Systems	Principles	Application
1	Conductometer	Conductance	Enzyme Substrate
2	Enzyme Electrodes	Amperometrics	Enzyme Immunological and Substrate System
3	Thermister	Calorimetrics	Enzyme, Products, Gases, , Antibiotics, Pollutants Vitamins, etc.
4	Piezoelectric Crystals	Mass Changes	Volatile Vapors and Gases
5	ION Sensitives Electrode (ISE)	Potentiometrics	Ions in the Biological Media
6	Wave /Optoelectronic guided and the fiber optics device	Opticals PH	Enzyme Substrate and Immunological System
7	Field Effects Transistor (FET)	Potentiometrics	Enzymes Substrates, Gases, Ions

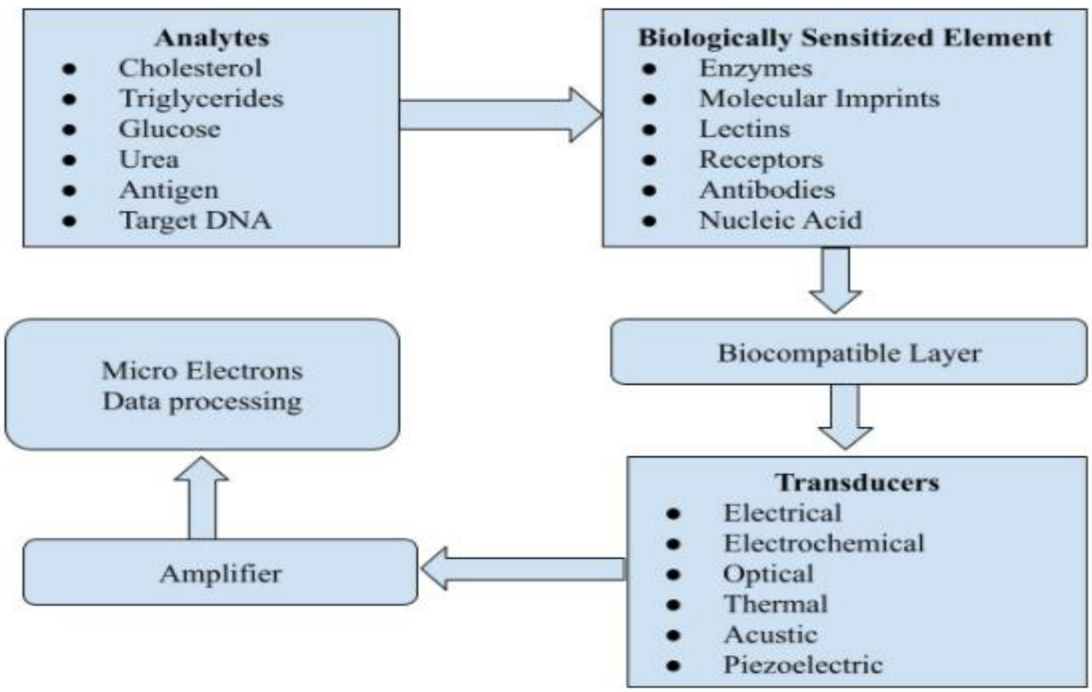

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Figure 1: The Principles of Nano-biosensor. These nano-receptors are crucial in the growth of potential nano-biosensors.

A. Advantages and Disadvantages of Nano-biosensors Over Conventional Biosensors

1) Advantages

- These instruments are highly sensitive, detecting single virus particles or extremely tiny quantities of a potentially hazardous substance.
- Nano-biosensors offer the greatest performance at the atomic scale.
- Nano-biosensors also have greater surface-to-volume ratio.

2) Disadvantages

- Nano-biosensors are extremely sensitive and vulnerable to errors.
- Nano-biosensors are still in their infancy.

B. Types of Nano-biosensors

1) Mechanical Nano-biosensors

Nanoscale mechanical forces between biomolecules offer an interesting platform for investigating biomolecular interactions. This helps in the development of biosensors that are compact, responsive, and label-free [19]. Beams may be used to categorize biomolecules by deflecting when they come into contact with one [20].

In general, three techniques are utilized to transform the identification of the analyte of interest into micromechanical cantilever bending. Nano-mechanical instruments are useful since they are highly mass adaptable. As the size of the analyte molecules reduces, the mass lowers which results in the inclusion of connected analyte molecules resulting in a greater proportionate change to the main mass [21,22].

2) Nanowire Biosensors

A nanowire biosensor is a mixture of two molecules that are highly susceptible to external signals: single-stranded DNA (which serves as the "detector") and a carbon nanotube (which serves as the "sensor") (serving as the transmitter) [23]. Nanowires' surface properties can be quickly changed by adding chemical or biological molecular ligands, making them analyte-independent. This converts the chemical binding event on their surface into a transition in nanowire conductance in a highly sensitive, real-time, and quantitative manner [24]. Highly sensitive, real-time electrically dependent sensors for biological and chemical organisms have been created using boron-doped silicon nanowires [25].

3) Electronic Nano-biosensors

Electronic nano-biosensors detect the binding of a target DNA that creates a bridge between two electrically separated wires on a microchip by utilizing electronics. Each chip contains multiple sensors that may be handled individually with capture probes for several target DNA molecules from the same or different species.

C. Role of Nano-biosensor in Agriculture

Nanomaterial based biosensors presently provide interesting potential in contrast to conventional biosensors. Nano-biosensors offer unique advantage, like enhanced identification specificity /sensitivity and have tremendous potentials for usage in a number of sectors, including environmental and bioprocess management, food quality control, irrigation, biodefense, and, most importantly, medicinal applications. However, we're interested in the role of nano-biosensors in agriculture and agro-products in this case.

II. DISCUSSION

A biosensor combine a biological element with a physiochemical transducer for produce an electrical signals proportional to a single analytic, which is subsequently transmitted to a detector. Agriculture's access to net land and water resources is rapidly decreasing, resulting in significant losses in agricultural output. These issues can only be addressed successfully with the assistance of new technologies, which are continuously being created. Nanotechnology is presently regarded as a fast growing field with the potential to revolutionize the agriculture sector.

III. CONCLUSION

Within the sensor culture, there is a strong drive to increase the capacity for real-time sensing. By developing screening techniques, nanotechnology has the potential have tremendous influence on energy, the economy, and the environment. New ways to incorporate nanotechnologies into nano-biosensors should be explored, but any possible dangers to the environment or human health should be recognised. We anticipate that nanotechnology will alter agriculture by focusing research and development efforts on achieving sustainable agriculture goals, with focused efforts by the academia and governments in the developing like enabled agro-products. By designing screening techniques, nanotechnology has the potential to have a major influence on the energy, economy, and the environment. New ways to incorporate nanotechnologies into nano-biosensors should be explored, but any possible dangers to human or environment health should be recognised. Nano-biosensors with brilliantly devoted small sensors with highly downsized sensors were conceived and produced in the 21st century base on the nanotechnology principles. By merging nanosciences, electronics, computers, and biology, researchers have lately developed biosensors with unparalleled spatial and temporal accuracy and endurance.

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