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REVIEW ARTICLE

Biosensor and It's Application in Food Industry

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ABSTRACT
Biosensor is a device which is use to determine the concentration of the particular analyte present in the sample. Biosensor generally is classified on the basis of biological element use and the type of transuding element use in them. The use of biosensor in the food industry is to detect the food component or to detect the presence of microorganisms. Different types of biosensor are there on the basis of technique use with them optical biosensor, impedance biosensor, fluorescence label biosensor etc.
***KEYWORDS**: Biosensor, Transducer, Bioluminescence, Impedance.*

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INTRODUCTION

Biosensor is a device which involves incorporation of bioactive material with transducing element for detecting the concentration or activity of analyte present in the sample [1].

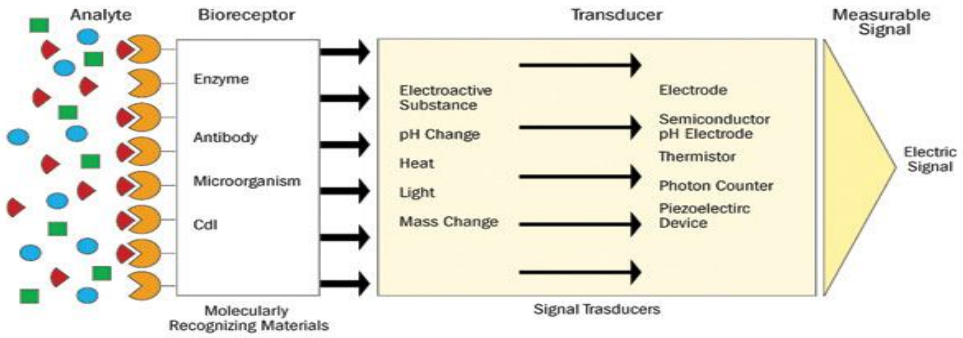

FIGURE**1**. BIOSENSOR AND ITS PARTS.

MAJOR COMPONENTS OF BIOSENSOR

Biologically Active Material: a biological derived material is the one that interact with the analyte under study .e.g. Antibodies enzymes, microorganisms etc.

Detector Element: the detector element which is also called as transducer which transform biological signal into another signal that can more easily measure. I.e. amplified signal e.g. optical transducer, electrochemical transducer, calorimetric transducer etc.

Signal Processor: It is used to display the result in user friendly manner.

CLASSIFICATION OF BIOSENSOR

Biosensor is broadly classified into two classes:

I) ON THE BASIS OF BIOLOGICAL ELEMENT

a) **Enzyme Biosensor**: enzyme because of its high selectivity and activity towards substrate are the best candidate to be used as biologically active materials. Most of the enzymes used in biosensor are Oxidizes but there are certain limitations as their activity is susceptible to pH, temperature, ionic strength etc.

b) **Microbial Biosensor**: it uses microorganism as biological element .The metabolism of microorganism is used as basis of their activity. They are cheaper & versatile as compared to other sensor elements.

c) **Antibody Based Biosensor:** It uses antibodies as sensor. They are immobilized on the surfaces by covalent /Ionic/ Vander wall attachment in conjugation with amino-carboxyl groups etc.

II) ON THE BASIS OF TRANSDUCING ELEMENT

a) **Electrochemical transducers**: The two common types of electrochemical transducers are Amperometric and Potentiometric transducer. In the Amperometric transducers the potential between the two electrodes is set and current produced by oxidation –reduction of electro active species is measured and correlated with the concentration of the analyte of the interest [5]. The Potentiometric measures the potential of electrochemical cell with very low current value.

b) **Optical Transducer**: they are used for determining the concentration of analyte on the basis of change in optical density at appropriate wavelength. I.e. Total Internal Reflection is measured with a Photodetector as a function of incident angle.

c) **Calorimetric Transducers**: it is used for calculating the heat of biochemical reactions by measuring the temperature difference between the reaction vessel and isothermal heat sink surrounding it.

THE USE OF BIOSENSOR IN FOOD INDUSTRIES CAN SUBDIVIDED INTO TWO GROUPS

I) **ENZYME BIOSENSOR FOR DETECTING FOOD COMPONENTS**:

Biosensor are used in industries [2] as Wine, Beer ,Soft drink etc. for detecting or measuring the carbohydrates from Alcohol , Amino acids, Amines, Amides, Phenol etc.(Table 1)

FOOD COMPONENTS	ENZYME USED
Glucose	Glucose oxidase
Fructose	Fructose -5-dehydrogenase
Sucrose	Glucose Oxidase, Mutarotase,Invertase
Lactose	Galactose oxidase & Peroxidase
Glutamate	Glutamate Oxidase
Malate	MalateDehydrogenase ,Diaphorase
Glycerol	Glycerol Dehydrogenase
Cholesterol	Cholesterol Oxidase
Essential fatty acids	Lipoxygenase
Ethanol	Alcohol Dehydrogenase
Choline	Choline Oxidase

II) **BIOSENSOR FOR DETECTING BACTERIA IN FOOD**:

The detection of pathogenic bacteria can be done in two ways:

i) **DIRECT DETECTION**: these biosensors are those in which Biospecific reactions are directly measured in real time by measuring the physical changes induced by the complex formation.

- **Optical Biosensor**: These biosensors are used for direct detection of bacteria. These sensors are able to detect the small change in refractive indices, when cell bind to receptor which are immobilized on the transducer[3].The common optical biosensor which are used now a days are Elapsometric, Ewascent wave interferometer, resonant mirror, and piezoelectric biosensor.
- **Bioluminescence Biosensor**. The use of photons as a byproduct of reaction for Bio analytical sensor led to the so called bioluminescence biosensor which may be use to detect the presence or physiological state of cell. E.g. Luciferase reporter phage in which the gene encoding Luciferase incorporated into the genome of bacterial viruses.
- **Electrical impedence biosensor**: In this Biosensor microbial metabolism bring increase in both conductance & capacitance and thus cause a decrease in impedance[4]. The biosensor is based on impedance measure of adherently growing cells on inter digitized electrode structure. I.e Cell density, growth of cells on electrode changes the impedance of Biosensor.

ii) **INDIRECT DETECTION**: These biosensors are those in which a preliminary bio chemical reaction takes place and the product of the reaction are detected by a sensor.

- **Fluorescence labeled biosensor**: Microorganism have protein & polysaccharides in their outer coat which permit development of bioassays for bacterial detection. In Fluoro immunoassay, Fluor chrome molecules are used to label immunoglobulin. These Fluor chrome molecules absorb short wavelength light and emit higher wavelength light which detect by the fluorescent

microscopy. FITC, RITC, BSA are most useful Fluorochrome used to tag the antibody eg.Using an Antibody to the protective protein express with the anthrax toxin for use of detection of Anthrax.

- **Microbial metabolism based biosensors**: Micro organism is able to transducer their metabolic Redox reaction in to quantify electric signals by using Oxido Reductase reaction and mediator.
- **Flow immune sensors**: Now days, many of the assays for microbes are based on Elisa using micro titration plates on completion of Chromogenic reaction, the quantitative determination is done using Elisa reader e.g. *E.coli* detection.

CONCLUSION

Living organisms, biological components like antibodies and enzymes work as natural sensing and controlling "devices." The most widely accepted definition of a biosensors is: "a self-contained analytical device that incorporates a biologically active material in intimate contact with an appropriate transduction element for the purpose of detecting (reversibly and selectively) the concentration or activity of chemical species in any type of sample.

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