Detection Of Food Borne Pathogen Using Biosensor

Priyadarshini, S[1]., Krishna kumar, S[2]., Conchita, S[3]. and Manoj, M[1].
[1] Department of Agricultural Microbiology, University of Agricultural Sciences, GKVK, Bengaluru.
[2] Department of Agricultural Entomology, University of Agricultural Sciences, GKVK, Bengaluru.
[3] Department of Plant Biotechnology, University of Agricultural Sciences, GKVK, Bengaluru
Corresponding Author : priyaselvaraj0606@gmail.com

Manuscript No: KN-V2-01/010

Introduction

Biosensor acts as a sophisticated analytical tool, translating biological reactions into electrical signals. With respect to the food processing industry, the major challenge lies in the need for rapid and cost-effective methods of detecting pathogens in food. This paper explores how biosensors offer quick identification of contaminants, pathogens, allergens and pesticide residues in food products. The other areas where biosensors come into play include checking for confirming a product's ingredients list, guaranteeing freshness in a product and monitoring raw material conversion. Biosensors contain untapped potential that could revolutionize analysis within agriculture and food industries.(Ali et al., 2020).

Components of biosensor

Biosensors consist of two primary elements: a component for recognizing the target, which could be receptors, nucleic acids, or antibodies, and a signal transducer that converts this target recognition into physically observable signals. Various optical transducers, such as internal reflection, fluorescence resonance energy transfer (FRET), chemiluminescence, bioluminescence, and surface plasmon resonance (SPR), are utilized in manufacturing biosensors. These transducers play a crucial role in converting biological responses into detectable signals. Broadly categorized, biosensors can be classified into three groups based on their transduction elements: optical biosensors, mechanical biosensors, and electrochemical sensors(Jayan et al., 2020).

Optical biosensors

Optical biosensors can discern microorganisms in food by detecting changes in refractive index or thickness resulting from the attachment of bacterial cells to receptors on the transducer surface. These biosensors incorporate a biodegradable polymer that interacts with analytical enzymes produced by microorganisms during the natural product's decay. As bacterial populations increase, the heightened enzyme secretion, responsible for food degradation, becomes apparent through observable changes in the polymer. Key optical techniques include colorimetry, fluorescence, chemiluminescence, and surface plasmon resonance (SPR). Specifically, immunoassays utilizing a sandwich approach have been developed to diagnose pathogenic bacteria in poultry, such as Salmonella typhimurium, Staphylococcus aureus, Salmonella enteritidis, and Campylobacter jejuni(Alameret al., 2018).

Electrochemical biosensors

Electrochemical biosensors are classified based on the diverse electrical signals generated in response to the presence of specific targets, encompassing impedimetric, potentiometric, amperometric, electrochemiluminescent, voltammetric, and conductometric methods. An example application involves the detection of Salmonella typhimurium in apple juice using a potentiometric biosensor that combines a gold nanoparticle polymer inclusion membrane. This approach successfully achieved a detection limit of 6 cells/mL(Silva et al., 2019).

Mechanical biosensors

Mechanical biosensors operate by quantifying the deflection of a mass-sensitive sensor surface, a result of the bonding of target analytes to the functionalized surface. In the context of detecting the foodborne pathogen Campylobacter jejuni, lectins were utilized and immobilized as the recognition element on the surface of the Quartz Crystal Microbalance (QCM) chip(Masdoret al., 2016).

Bioluminescence

Bioluminescence plays a crucial role in real-time process monitoring by generating bright light through living microorganisms. Various organisms, such as bacteria, dinoflagellates, fungi, fish, insects, shrimp, and squid, emit light as a result. The enzyme luciferase catalyzes the bioluminescent reactions in these organisms, and in specific cases, the substrates involved are termed luciferins. Bioluminescence proves highly efficient for rapid spot tracking, providing test results in less than 15 minutes. This method has been applied to assess various food items, including fresh and pasteurized dairy products, meat and poultry products, beer, and fruit products(Ali et al., 2020).

Conclusion

In recent years, there has been a significant increase in reported cases of foodborne pathogens, posing serious health risks and potential fatalities. Rapid detection of these pathogens is crucial. Biosensors offer a promising alternative to conventional analytical methods due to their advantages in terms of quick analysis, cost-effectiveness, precision, and reliability. Advancements in technology enable the development of biosensors that are not only more sensitive and faster but also portable, comparably sensitive, and economically viable.

Reference

Alamer, S., Eissa, S., Chinnappan, R., Herron, P. and Zourob, M., 2018. Rapid colorimetric lactoferrin-based sandwich immunoassay on cotton swabs for the detection of foodborne pathogenic bacteria. Talanta, 185, pp.275-280.

Ali, A.A., Altemimi, A.B., Alhelfi, N. and Ibrahim, S.A., 2020. Application of biosensors for detection of pathogenic food bacteria: a review. Biosensors, 10(6), p.58.

Jayan, H., Pu, H. and Sun, D.W., 2020. Recent development in rapid detection techniques for microorganism activities in food matrices using bio-recognition: A review. Trends in Food Science & Technology, 95, pp.233-246.

Masdor, N.A., Altintas, Z. and Tothill, I.E., 2016. Sensitive detection of Campylobacter jejuni using nanoparticles enhanced QCM sensor. Biosensors and Bioelectronics, 78, pp.328-336.

Silva, N.F., Magalhães, J.M., Barroso, M.F., Oliva-Teles, T., Freire, C. and Delerue-Matos, C., 2019. In situ formation of gold nanoparticles in polymer inclusion membrane: Application as platform in a label-free potentiometric immunosensor for Salmonella typhimurium detection. Talanta, 194, pp.134-142