An Overview on Detection Methods of Food Borne Disease

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ABSTRACT: ***There in context of increasing population as well as diminishing earth resources, food safety is a significant issue. Bacteria, viruses, fungi, as well as parasites pollute food, causing diseases including hemolytic uremic syndrome, irritable bowel syndrome, including Guillain–Barre syndrome. As a result, pathogenic microorganism detection is critical for food safety. Bacteria, virus, parasites, and fungi found in the environment cause human disease and may easily contaminate edible food. Food-borne illnesses are illnesses brought on by eating contaminated foods. Food spoilage is the process by which microorganisms change the biochemical properties of food components to make it less appealing to consume. Biological techniques, biosensors, and methods is based on spectroscopic, immunology, including nucleic acids are examples of detection methods. We'll go over sophisticated detection methods for analyzing hazardous chemicals in food in this article.***

KEYWORDS: ***Food Material, Food-Borne Disease, Detection Techniques, Contamination, Pathogenic Microbes.***

1. INTRODUCTION

Bacteria, viruses, parasites, and fungus that occur in the environment cause illnesses in humans and readily contaminate edible food items. Food-borne diseases are illnesses that are caused by consuming contaminated foods. Food spoiling is the process by which bacteria alter the biochemical characteristics of food components to reduce the attractiveness of food for ingestion. Several organizations, including the World Association for Food Protection, the World Resources Institute, the Global Food Program, the Agriculture Organization of The united, as well as the International Food Information Council, monitor food safety and security (IFIC). Sustainability, climate change, biological variety, nutritional change, water availability, and population expansion are all variables that may influence food safety and security. A compromised immune system is the most significant element that leads to the symptoms and severity of food-borne illnesses. To maintain food safety and quality, routine screening of microbial development in food material is required[1].

1.1 Techniques of detection:

There are many methods for detecting harmful bacteria in food, which are classified as biochemical or biological detection approaches. Biochemical detection methods include enzyme-linked immunosorbent assay (ELISA), enzyme-linked fluorescence assay (ELFA), lateral flow assay, and magnetic separation techniques, whereas biological approaches are classified as culture-dependent or culture-independent. Different kinds of detection methods for harmful microorganisms are employed in food science[2], [3].

1.2 Detecting biological agents:

Culture-dependent techniques are more time-consuming and labor-intensive. The procedure of collecting samples from food products (pathogens infected), serial dilution, innoculate on selective and appropriate medium for bacterial growth, and incubation becomes much too lengthy. The incubation time for food-borne diseases is usually 12–24 h and may vary up to 72 h depending on the bacterial strains. During the assessment of growth rate and mortality rate, it is also essential to determine the number of bacteria alive. Colony-forming units (CFUs) indicate the bacteria's gradation on the material. Bioluminescence is a well-known technique for detecting pathogens that relies on the capacity of enzymes to produce light during enzymatic processes. Phage typing is an old technique for detecting pathogens that has been used as a biological tool for a long time. This technique is often used to determine the source of infection in a sample and to identify a specific bacterial strain[4], [5].

1.3 Methods that are not influenced by culture:

Food microbiologists' primary emphasis is on the fast detection and identification of food pathogens with flawless accuracy. The advent of molecular-based techniques made it simpler for microbiologists to accomplish their objectives. Rapid and multiplex detection is attributed to molecular-oriented methods such as ELISA and PCR.

As a result, novel detection methods such as matrix-assisted laser desorption/ionization–time of flight (commonly known as MALDI–TOF) and electrospray ionization–mass spectrometry (ESI–MS) arose. These methods not only offer precise findings, but they also aid in the identification of nonviable microbial cells.

1.4 The detection of biochemicals:

The biochemical technique entails a number of traditional methods to detecting infections grown on agar plates, which gives microbiologists a starting point for identification. Different chemical properties are important in the detecting procedure. There are a variety of biochemical assays available to aid in the identification of infections. Microbes have been detected using chemical characteristics such as indole generation test, methyl red, triple sugars iron agar, Voges–Proskauer, citrate consumption, catalase, oxidase, starches hydrolysis, carbohydrates fermentation, and ammonia oxidation test. Nucleic acid-based techniques and immunological-based methods have been developed and are now in use to offer greater accuracy and specificity[6]–[8].

1.5 Biosensors:

The term sensor comes from the Latin word whole, which literally means "to perceive." It is defined as the devices that are utilized to convert the generated signals into perceivable signals. Devices that convert a mechanical, thermal, acoustic, magnetic, electrical, or radiative action into a quantifiable and recordable electrical signal may be described as this. Biosensors are made up of a mix of transducers and biological components, and both must be explained. Biosensors are analytical devices that use a biorecognition element to convert a biological reaction into a quantifiable signal

1.6 Biosensors based on electrochemistry:

In the last several decades, researchers have been working on the development of electrochemical biosensors for pathogenic detection in the food industry. For the detection of harmful microorganisms in food, electrochemical biosensors have been extensively utilized and researched. Electrochemical biosensors have a quicker reaction time than conventional biosensors and may be used in turbid liquids. The signal that was measured, which comprises impedance, current, and potential, is used to classify electrochemical biosensors. When these methods are coupled with great specificity, they allow the creation of e-aptamer techniques. The presence of harmful bacteria in food samples in a consistent pattern complicates the identification procedure. Label-free biosensors utilize a receptor molecule linked to the transducer to detect a particular analyte in a sample. The electrochemical signals are initiated by the bio complex, making the process easier to regulate and the test simpler.

1.7 Optical biosensors are a kind of optical biosensor:

Optical biosensors are used to identify microorganisms and food pollutants quickly. created a multiplex optical fiber technique for detecting E. coli O157:H7, Listeria monocytogenes, and Salmonella enterica, among other food-borne bacterial infections. The samples were infected in meat, beef, and chicken in the experiment, and the pathogens were detected using the previously suggested biosensors. An optical biosensor detects changes in light's phase, frequency, and amplitude. A light source, transmission medium, optical detecting system, and a bifunctional receptor mounted on a surface are the components of an optical biosensor.

1.8 Methods of immunology:

Antigen and antibody specific binding is based on an immunological viewpoint, in which the antigen attaches to the antibody in the epitope locations that are accessible. ELISA, in which the chemicals are recognized by color change using antibodies, is one of several immunological techniques that have been employed for the fast identification of pathogens in food. ELFA is an immunologically based technique comparable to ELISA, with the exception that it is considerably more sensitive to biochemical testing. Immunomagnetic separation (IMS) is also used to isolate cells from a variety of bodily fluids. IMS is a commonly used method for extremely efficient separation, concentration, and detection of harmful microorganisms such as bacteria, virus, and other biological substances using immunomagnetic beads. The production of magnetic beads in the IMS system involves two techniques: emulsion polymerization and emulsion evaporation. Magnetic beads are made from a variety of materials, including chitosan, cellulose, natural polymers, and other organic and inorganic compounds.

1.9 Microarray analysis of DNA:

DNA microarray is one of the most recent breakthroughs in molecular technology. DNA microarrays, when used in conjunction with bioinformatics, provide a broad variety of possibilities for identifying the target gene or sequence as well as a route for investigating food-borne microbes. The most frequent applications of this technology are in environmental and clinical diagnostic systems. Microarray technology, on the other hand, is used to analyze gene expression and is useful in the identification of food-borne diseases. It is also used in agriculture to identify pathogenic DNA in food safety procedures. Molecular techniques have many benefits over traditional methods.

1.10 Polymerase Chain Reaction (PCR):

The polymerase chain reaction (PCR) is a sensitive method for amplification of DNA used by molecular biologists. Taq polymerase, which aids in the insertion of nucleotides, is linked with this method. This technique's success aided in the amplification of huge amounts of DNA of known size and fragment. The problem of tissue limitation has been resolved. The real-time polymerase chain reaction (RT-PCR) is a new isothermal method for detecting a wide range of infections. Cider and other fermented foods have been detected quickly using multiplex PCR. Cider has been utilized in over 25 nations, making it more cost-effective. Many fermented foods, such as cider, have utilized lactic acid bacteria as starters. The genomic DNA was collected from the culture during the stationary phase and quantified using a spectrometer. A 1 kb DNA ladder was utilized in this experiment. 16 s verified the bacterial strain Sanger was represented by a single strain, which allowed the PCR to be performed immediately on the colonies selected from the plates. The lactic acid bacteria (LAB) plays an essential function in fermented foods and may create problems, therefore it's more necessary to get rid of it in the long term. The use of universal primers and specific bacterial strains assisted in the identification and location of bacterial strains in the samples. Multiplex PCR has been used to identify food pathogens in fermented food products in this manner[9].

1.11 Techniques that are different:

Aside from these, there are several additional methods, such as nucleic acid sequence-based amplification (NASBA), which is an isothermal amplification technique for RNA. Campylobacter spp., Listeria monocytogenes, as well as Salmonella enterica ser. Enteritidis in different foods, as well as Cryptosporidium parvum in water, may all be detected with this technique. In the case of detection, 16rRNAs and mRNAs are utilized as target molecules. For the identification of bacteria such as E. coli, culture-based techniques such as Sorbitol Macconkey (SMAC) may be employed as selective and differential medium. Other culture-based techniques that may be used to identify bacteria in food include CHROM agar and RAINBOW agar[10].

2. DISCUSSION

Bacteria, viruses, parasites, and fungus that occur in the environment cause illnesses in humans and readily contaminate edible food items. Food-borne diseases are illnesses that are caused by consuming contaminated foods. Food spoiling is the process by which bacteria alter the biochemical characteristics of food components to reduce the attractiveness of food for ingestion. In the context of increasing population and diminishing earth resources, food safety is a significant issue. Bacteria, viruses, fungi, and parasites contaminate food, causing diseases including hemolytic uremic syndrome, irritable bowel syndrome, and Guillain–Barre syndrome. As a result, pathogenic microorganism detection is critical for food safety. The integration of biosensors with other disciplines such as nanotechnology leads to advancements in multiplex detection capabilities as well as certain benefits in biosensor design. Instrumentation and immunological approaches such as PCR, GC–MS, MALDI–TOF, bioluminescence, and a few cyclometric methods, among others, provide a novel means of detecting food-borne infections that is much easier than previous methods. MALDI–TOF is an example of a technology that allows for quicker identification of biomarker profiles. Because PCR is so essential in the process of DNA amplification, it's also extremely significant in disease detection. Overall, these methods will become more important in the identification and monitoring of food-borne pathogens in the future.

3. CONCLUSION

Significant research has been done in the area of food technology for the detection of pathogens during the last several decades, and biosensor-based methods, in particular, have led the way for fast pathogen detection. Biosensors have developed as viable devices for real-time pathogen detection; however, electrochemical biosensors have played a critical role since they are readily portable and may be utilized in situ. Because of its quick reaction and cost-effective equipment, this biosensor is extensively utilized. Electrochemical biosensors offer greater benefits than other kinds of biosensors, such as optical and mass-based biosensors. The turbidity of the sample has no effect on the sensor's detection capability, and it has a rather high sensitivity. Optical and mass-based biosensors, on the other hand, are used in the detection of biological samples when the target analyte is low. Despite the fact that the field of biosensors has grown beyond our comprehension, the area of biosensors remains open to further development. However, the sample condition affects the biosensor's functioning, and noninteraction of the biorecognition element with the target may result in incorrect findings. The integration of biosensors with other disciplines such as nanotechnology leads to advancements in multiplex detection capabilities as well as certain benefits in biosensor design. Instrumentation and immunological approaches such as PCR, GC–MS, MALDI–TOF, bioluminescence, and a few cyclometric methods, among others, provide a novel means of detecting food-borne infections that is much easier than previous methods. MALDI–TOF is an example of a technology that allows for quicker identification of biomarker profiles. Because PCR is so essential in the process of DNA amplification, it's also extremely significant in disease detection. Overall, these methods will become more important in the identification and monitoring of food-borne pathogens in the future.

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