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MALDI-TOF Mass Spectrometry: A Technique for Identification of Foodborne Pathogens

Food safety is of major concern in any of the food processing industries as most of the freshly packed foods are subjected to microbial attack leading to growth of microorganisms. Growth of microbes leads to change in taste, smell, odour of packaged foods which is the huge loss for food industries as it is unfit for consumption. Therefore, there is need to identify and detect these microbes thus ensuring food safety. Several conventional methods are available, but all these methods are time consuming and laborious. But in recent years MALDI-TOF mass spectrometry is gaining popularity because it is more accurate, rapid method of microbe detection and identification.

INTRODUCTION

At present consumers are demanding more fresh food and are mostly depending on freshly packed readymade foods. From food processing and packaging until it reaches the final customer there are several chances of microbial spoilage that can occur. Food spoilage by microbes incurs huge losses to food processing industries as these foods are unfit for consumption. Microbial spoilage of foods leads to change in colour, taste and smell of foods. And if these foods are consumed it leads to serious foodborne illness and impact human health. Sometimes even there is outbreak of microbial hazards when these foods are consumed. Thus in-order to control and minimize these microbial hazards, accurate identification of these food borne pathogens becomes essential.

Identification of the food borne pathogens is useful to take precautionary measures to tackle the outbreak in future. And it also provides information about at what point of food processing the spoilage is occurring. Various identification methods have been developed like phenotypic methods which is based on culturing of organisms on differential media which is a time-consuming process and molecular methods include isolation of DNA and grouping the organisms based on sequences of 16s rRNA. These methods are time consuming and laborious. The development of new techniques like matrix assisted laser desorption/ionisation (MALDI) time of flight (TOF) mass spectrometry is faster in identification and detection of food borne pathogens and it gives more accurate results when compared with conventional methods.

ABBREVIATIONS

MALDI- Matrix-assisted laser desorption/ionization
TOF- Time of flight
PMF- Peptide mass fingerprinting

MALDI TOF MS

An analytical technique called mass spectrometry involves ionizing samples into charged molecules and measuring the ratio of their mass-to-charge (m/z). MALDI-TOF mass spectrometry uses matrix-assisted laser desorption/ionization (MALDI) as the ion source, and TOF analysis as the mass analyser. Analyte molecules are ionized using MALDI by striking a matrix of small molecules with a laser, releasing them as gas molecules without fragmenting or decomposing them.

MALDI-MS

In order to avoid direct contact with the ionizing beam, analytes are crystallized with matrix. They absorb UV laser radiation and pass it on to the proteins, which become positively ionized. The generated ions will be released from the proteins. An electric field will then accelerate these charged molecules (+1).

TOF

After passing through the electric field, the ions enter a tube and are separated based on their mass-charge. As size and speed of ions are inversely related, the ions move at different speeds. Each passing ion is then detected by a time-of-flight analyser to create peaks on the spectrum, which are

then compared with a database. By comparing this technique with conventional methods, the identification of bacteria takes much less time based on the sample quality, purity, and number of references available in the database.

- ● Analyte spots
- ● Matrix spots
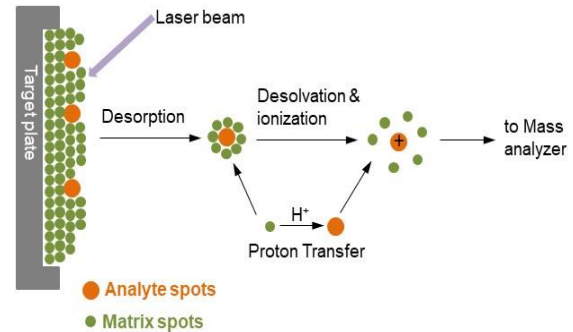
MALDI TOF MS IN FOOD MICROBIOLOGY

The MALDI TOF MS can be used in a variety of fields for detecting molecule types such as sugars, nucleic acids, and proteins in chemical laboratories. Moreover, this technique is increasingly being used in microbiology laboratories to identify microorganisms at the species level. In case of food microbiology MALDI TOF MS is used for identifying and detecting food borne pathogens.

The principle is based on a laser beam ionising bacterial proteins and creating characteristic peaks (spectrum). Microbes are identified using MALDI-TOF MS by comparing the unknown organism's peptide mass fingerprint (PMF) to the PMFs in the database, or by matching the masses of unknown organism's biomarkers to the proteome database.

CONCLUSION

Food borne disease outbreaks leads to serious illness issues in humans. To control these disease outbreaks fast and accurate detection and identification methods must be developed to minimise these microbiological hazards. Therefore, pathogen identification with MALDI TOF mass spectrometry can be used in identification of cause of food borne illness and is useful for taking precautionary measures.

REFERENCES

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