Research & Reviews: Journal of Food and Dairy Technology

e-ISSN: 2319-1234

Mass Spectrometry in Food Technology: Applications Principles and Analytical Advances

Priya Sharma*

Department of Food Science and Technology, University of Delhi, New Delhi, India

Editorial

Received: 01-Sep-2025, Manuscript No. jfpdt-25-186608; **Editor assigned:** 04-Sep-2025, Pre-QC No. jfpdt-25-186608 (PQ); **Reviewed:** 22-Sep-2025, QC No jfpdt-25-186608; **Revised:** 25-Sep-2025, Manuscript No. jfpdt-25-186608 (R); **Published:** 30-Sep-2025, DOI: 10.4172/2319-1234.13.020

***For Correspondence**

Priya Sharma, Department of Food Science and Technology, University of Delhi, New Delhi, India

E-mail: priyasharma.aquafood@du.ac.in

Citation: Priya Sharma, Mass Spectrometry in Food Technology: Applications Principles and Analytical Advances . RRJ Hosp Clin Pharm. 2025.13.020.

ABSTRACT

Mass spectrometry (MS) has emerged as a critical analytical tool in food technology, providing precise identification, quantification, and structural elucidation of food components. Its applications span food quality assessment, safety evaluation, detection of contaminants and adulterants, and metabolic profiling. This article reviews the principles of mass spectrometry, various ionization and detection techniques, and their applications in food analysis. It also highlights the advantages, limitations, and future perspectives of MS in advancing food technology and ensuring consumer safety.

Keywords

Mass Spectrometry, Food Analysis, Food Safety, Adulteration Detection, Metabolomics, Quality Control

INTRODUCTION

Mass spectrometry is a powerful analytical technique that measures the mass-to-charge ratio of ions to identify and quantify chemical compounds. In food technology, MS has revolutionized the ability to analyze complex matrices, detect trace contaminants, and monitor food authenticity.

Food products are chemically complex, containing proteins, carbohydrates, lipids, vitamins, minerals, and minor bioactive compounds. Traditional analytical techniques often lack the sensitivity and specificity to characterize these compounds comprehensively. MS overcomes these limitations, providing detailed molecular information essential for quality control, safety, and innovation in the food industry [1].

PRINCIPLES OF MASS SPECTROMETRY

The basic components of a mass spectrometer include:

Converts neutral molecules into charged ions. Common techniques in food analysis include: Suitable for polar and high-molecular-weight compounds. Used for proteins and large biomolecules. Used for small organic molecules [2]. Separates ions based on their mass-to-charge (m/z) ratio. Types include Quadrupole, Time-of-Flight (TOF), Ion Trap, and Orbitrap analyzers. Measures the abundance of ions to generate a mass spectrum.The resulting mass spectrum provides qualitative and quantitative information about food components and contaminants.

APPLICATIONS OF MASS SPECTROMETRY IN FOOD TECHNOLOGY

Identification and quantification of proteins, lipids, carbohydrates, vitamins, and bioactive compounds. Metabolomics studies to profile nutritional and functional components. Detection of pesticides, herbicides, veterinary drugs, and mycotoxins in food matrices. Identification of heavy metals and environmental pollutants. Detection of food fraud, such as substitution of high-value ingredients (olive oil, milk, spices) with cheaper alternatives. Traceability of geographic origin through isotopic and molecular profiling [3]. Characterization of fermentation metabolites in yogurt, cheese, wine, and beer. Monitoring lipid oxidation, Maillard reaction products, and flavor compounds. Quantification of bioactive peptides, polyphenols, and phytochemicals to develop health-promoting foods [4].

Advantages of Mass Spectrometry in Food Analysis

High sensitivity and specificity, capable of detecting trace levels of compounds. Rapid analysis of complex food matrices. Ability to provide structural information for unknown compounds. Adaptable to hyphenated techniques (LC-MS, GC-MS, LC-MS/MS) for enhanced separation and detection.

FUTURE PERSPECTIVES

Integration with omics technologies (proteomics, metabolomics) for comprehensive food profiling. Development of miniaturized and portable MS devices for on-site food testing. Enhanced automation and AI-driven data analysis for faster interpretation. Improved detection of emerging contaminants, allergens, and bioactive compounds to support functional food innovation [5].

CONCLUSION

Mass spectrometry has become an indispensable tool in modern food technology, enabling precise analysis of food composition, safety, and authenticity. With advances in instrumentation, hyphenated techniques, and data analytics, MS continues to transform food analysis, ensuring consumer safety, quality control, and innovation in functional foods. Its integration with modern biotechnological approaches and metabolomics will expand the potential for comprehensive food monitoring and sustainable food production.

ACKNOWLEDGEMENT

None.

CONFLICT OF INTEREST

None.

REFERENCES

1. Gross H. Mass Spectrometry: A Textbook (3rd ed.). Springer.2017.
2. Niessen A. Liquid Chromatography-Mass Spectrometry, Third Edition. CRC Press.2017.
3. Cagliani R, Russo R. Mass spectrometry in food authenticity and traceability. TrAC Trends in Analytical Chemistry,2019;116, 126–136.
4. Want E. Global metabolic profiling of plant and food products using mass spectrometry. Analytical Chemistry,2010; 82(6):243–254.
5. Castro-Puyana M, Herrero M. Advanced mass spectrometry-based strategies for food safety analysis. Analytical and Bioanalytical Chemistry,2013;405(17):5681–5695.