World Journal of Pharmaceutical and Life Sciences
WJPLS
www.wjpls.org
SJIF Impact Factor: 6.129

LCMS- A REVIEW

Mohammed Sayeed Uddin*[1], Dr. Osman Ahmed[1], Syeda Rakhshinda Zareen[1], Reshma[1] and Dr. Anas Rasheed[2]

[1]Department of Pharmaceutical Analysis, Deccan School of Pharmacy, Hyderabad.
[2]CSO, Gaelib Medications Private Limited, Hyderabad.

Corresponding Author: Mohammed Sayeed Uddin
Department of Pharmaceutical Analysis, Deccan School of Pharmacy, Hyderabad.

Article Received on 09/12/2022 **Article Revised on 29/12/2022** **Article Accepted on 19/01/2023**

ABSTRACT

Liquid chromatographers often choose LC/MS, a rapidly improving technique that combines LC with mass spectrometry. There is a method called liquid chromatography-mass spectrometry (LC-MS/MS) that combines HPLC (high-performance liquid chromatography) with mass spectrometry. Combining the physical separation skills of high-performance liquid chromatography (HPLC) with the mass analysis capabilities of mass spectrometry, it is an analytical chemistry method. For both qualitative and quantitative examination of pharmacological compounds, drug products, and biological materials, labs often utilise liquid chromatography-mass spectrometry (LC-MS/MS). Metabolic stability screening, metabolite identification, in vivo drug screening, impurity identification, peptide mapping, glycoprotein mapping, natural product de-duplication, and bio-affinity screening are just some of the numerous applications it has found in the pharmaceutical industry. Therapeutic drug monitoring (TDM), clinical and forensic toxicology, and doping control are just few of the fields where LC-MS is being routinely employed with great effectiveness. The demand for more robust analytical and bio-analytical methods that can sensitively and selectively distinguish target analytes from high complexity mixtures has been, and continues to be, a driving force behind the development of LCMS. Because of recent developments in equipment, the combination of liquid chromatography (LC) with mass spectrometry (MS) is now a potent two-dimensional (2D) hyphenated technology.

KEYWORDS: LCMS, HPLC, Peptide Mapping, Glycoprotein Mapping, Therapeutic Drug Monitoring (TDM), Forensic Toxicology, 2D Hyphenated Technology.

INTRODUCTION

The sensitivity of today's physical techniques of analysis allows for the extraction of useful data from very limited sample sizes. These are largely applied and in general are adaptable to automation. Due to these reasons, they are currently employed in product development, in the control of production and formulation, as a stability check during storage, and in monitoring the use of pharmaceuticals and treatments. There are numerous techniques used in Quantitative Analysis which may be roughly described as(2)- □ Chemical/classical Method (Titrimetric, Volumetric and Gravimetric method) □ Instrumental Method (Spectrophotometry, Polarography, HPLC, GC) (Spectrophotometry, Polarography, HPLC, GC) Liquid chromatography-mass spectrometry (LC-MS or HPLC-MS). is an analytical method that combines the physical separation powers of liquid chromatography (or HPLC) with the mass analysis capabilities of mass spectrometry. LC-MS is a versatile method with a wide range of uses due to its excellent levels of sensitivity and selectivity. It is the most widely used method in bioanalysis and is widely utilised in pharmacokinetic investigations of medicines. LC-MS also plays a part in pharmacognosy notably in the realm of molecular pharmacognosy when it comes to the components difference in the features of phenotypic cloning. The primary consideration is how to maximise the variation in the concentration of bioactive compounds in test-group plant cells relative to concentrations in control-group plants.

BASIC PRINCIPLE OF LCMS[3-5]

Liquid chromatography- High Performance Liquid Chromatography

Present day liquid chromatography often employs extremely tiny particles packed and operated at very high pressure, and is referred to as high performance liquid chromatography (HPLC); contemporary LC-MS procedures use HPLC apparatus, virtually entirely, for sample. For HPLC, adsorption is the foundational concept. High-performance liquid chromatography (HPLC) uses a high-pressure liquid (the mobile phase) to push a sample down a column packed with a stationary phase, often made up of irregularly or spherically shaped

particles selected or derivatized to achieve certain separations. Traditionally, HPLC techniques have been split into two categories, one based on stationary phases and the other on the polarity of the mobile phase that must be used with them. Reversed phase liquid chromatography is a technology that uses octadecylsilyl (C18) and similar organic-modified particles as a stationary phase in combination with pure or pH-adjusted waterorganic combinations such water-acetonitrile and water-methanol (RP-LC). Normal phase liquid chromatography is a method that uses a stationary phase made of a substance like silica gel to separate undiluted or diluted chemical compounds (NP-LC). In LC-MS equipment, RP-LC is the most common sample introduction method. Flow Separation 1.1 When using standard bore (4.6 mm) columns, the flow is typically divided at a ratio of -10:1. The employment of additional methods in tandem such as MS and UV detection are beneficial. However, if the flow is divided toward UV, the sensitivity of spectrophotometric detectors will be reduced. When the flow rate is below 200 L/min, mass spectrometry also becomes more sensitive.

Mass spectrometry

In analytical terms, the mass-to-charge ratio of charged particles is measured using mass spectrometry (MS). It is used to calculate the weight of a particle, find out what elements are in a sample or molecule, and deduce the structure of a molecule like a peptide or other chemical complex. Mass spectrometry (MS) is able to determine a substance's composition by analysing its mass-to-charge ratio after ionising the substance in question.[1] Samples are typically put into the MS equipment and vaporised as part of the standard MS operation. Different techniques (such as an electron beam's impact) are used to ionise the sample's constituents, resulting in the production of electrically charged atoms and molecules (ions). An analyzer uses electromagnetic fields to separate the ions based on the mass-to-charge ratio of the ions. Ions are frequently discovered using a quantitative technique. Processing the ion signal yields mass spectra. As an extra, MS instruments have three different parts. A device capable of transforming molecules in a gaseous sample into ions (or, in the case of electrospray ionization, move ions that exist in solution into the gas phase). An electromagnetic field-based mass analyzer for classifying ions according to their individual masses. A detector is a device used to determine the abundance of ions by measuring the value of an indicator quantity. Application of the method might be qualitative or quantitative. Among them are the methods of determining the structure of a chemical by watching its fragmentation and the identification of previously unknown compounds. Also, it may be used to learn about the basics of gas phase ion chemistry and to determine how much of a molecule is in a sample (the chemistry of ions and neutrals in a vacuum). MS is currently widely used in analytical labs to investigate the physical, chemical, and biological aspects of a wide range of substances.

Mass analyzer

LC/MS may make use of a wide variety of mass analyzers. Single quadrupole, triple quadrupole, ion trap, TOF, and quadrupole-TOF are only.

Interface

It took a long time for scientists to figure out how to make a smooth transition from working with liquids in a continuous flow to working with gases in a vacuum. However, this was altered with the development of electrospray ionisation. Atmospheric pressure chemical ionisation interfaces are sometimes utilised, although electrospray ion sources and their variants, including nanospray sources, are by far the most common.[1] Off-line MALDI deposition is now the most used method, while other methods, such as employing moving belts, have been tried. Direct-EI LC-MS interface is a novel method that is currently being developed; it links a nano HPLC system to an electron ionisation mass spectrometer.

Combination of HPLC and MS

In addition to its separation capabilities, HPLC adds very little to our understanding of how a molecule could behave. With reality, it is difficult in HPLC to be sure that a single chemical is present in a given peak. Mass spectrometry can be used to determine the exact molecular weights of each chemical in the peak, making it a useful tool for determining whether or not the substance is pure. For the purpose of studying a particular chemical, even the most basic mass spec may serve as a massspecific detector. In order to conduct a more in-depth structure-dependent analysis of the substances eluting off the HPLC system, more advanced mass detectors like triple quadrupole and ion-trap instruments can be used.

Various Applications of LCMS

First, in molecular pharmacognosy,[8] a liquid chromatography–mass spectrometer (LCMS) determines the contents and categories of different groups of cultured plant cells and selects the pair of groups with the largest different content of ingredient for the study of ingredient difference phenotypic cloning.

The Methodology of Compound Identification and Characterization Carotenoids.[9] Due to their poor thermal stability, carotenoids need the use of reversed phase high-performance liquid chromatography (especially HPLC) for purification processes rather than gas chromatography. Carotenoids isolated from human serum or tissue are often too tiny for nuclear magnetic resonance structure analysis. Since this is the case, only the most sensitive analytical techniques, such as Liquid Chromatography / Mass Spectrometry and High-Performance Liquid Chromatography (HPLC) with photodiode-array UV / visible absorbance detection, are suitable. Data from many analytical techniques, including high-performance liquid chromatography (HPLC) retention times, photodiode-array absorbance

spectroscopy, mass spectrometry, and tandem mass spectrometry, may be combined to validate the identity of carotenoids. Five LC/MS methods, including moving belt, particle beam, continuous flow rapid atom bombardment, electrospray, and Atmospheric Pressure Chemical Ionization, have been employed so far for carotenoid analysis (APCI). Electrospray and APCI, two of these LC/MS interfaces, are among the most user-friendly and are quickly gaining market share. These methods generate massive molecule ions and are just as sensitive (at the low pmol level).

Three-way analysis: quantitative, qualitative, and contextual

Performing Quantitative Bioanalysis on a Range of Biological Samples.[13] Quantitation of biogenic amines, pharmacokinetics of immunosuppressants, and doping control are just few of the many domains where LC-MS/MS technique has found use. Recent developments in the field of quantitative bioanalysis, such as automation of LC-MS/MS instrumentation, parallel sample processing, column switching, and the use of more efficient supports for SPE, are driving the trend toward shorter sample clean-up and total run times, resulting in a high-throughput methodology. Some recently developed methods of chromatography, such as ultraperformance liquid chromatography with microscopic particles (sub-2 m) and monolithic chromatography, are more rapid, more precise, and more sensitive than their predecessors.

CONCLUSION

Detection of General nanoflowers may be accomplished via LCMS analysis. It is expected to pave the way for a wide variety of innovations in medication delivery systems, biosensors, biocatalysts, and bio-related gadgets. It is anticipated that novel synthesis principles, novel hybrid nanoflowers, and elaborate processes will arise. Nanoflowers should be studied more closely for their potential use in bio-catalysis and enzyme mimetics, tissue engineering, and the design of highly sensitive bio-sensing kits; the creation of industrial bio-related devices with advanced functions; and the exploration of the biocompatibility, syntheses, and modifications of hybrid nanoflower structures and properties.

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