ECRONICON OPEN ACCESS

EC PHARMACOLOGY AND TOXICOLOGY

Short Communication

# Hyphenated Analytical Techniques in Analytical Chemistry

**Kishor S Jain***

*RJSPMS College of Pharmacy, India*

***Corresponding Author:** Kishor S Jain, RJSPMS College of Pharmacy, India.

**Received:** February 21, 2023; **Published:** March 17, 2023

## Abstract

In the field of chemical and pharmaceutical analysis, hyphenated techniques range from the combinations involving separation-separation, separation-identification and identification-identification techniques and are widely used nowadays, as they hold many advantages like fast accurate analysis, a higher degree of automation, higher sample throughput, better reproducibility, specificity and sensitivity. They also reduce contamination due to closed systems and offer simultaneous separation and quantification, leading to better analysis.

In the past decade, their use has increased manifold and therefore, it is thought imperative to briefly discuss the latest progress in this field. In the present article, an attempt has been made to briefly mention some information on various hyphenated techniques like LC-MS (Liquid Chromatography-Mass Spectroscopy), GC-MS (Gas Chromatography-Mass Spectroscopy), LC-IR (Liquid Chromatography-Infra-Red Spectroscopy), as well as, LC-MS-MS (Liquid Chromatography-Mass Spectroscopy-Mass Spectroscopy), LC-NMR-MS (Liquid Chromatography-Nuclear Magnetic Resonance-Mass Spectroscopy), etc.

***Keywords:*** *Hyphenated Analytical Techniques; Analytical Chemistry*

## Introduction

A hyphenated technique in analytical chemistry and bio-chemistry means the combination or coupling of two or more different analytical techniques with the help of a proper interface to separate and detect chemicals from solutions. Mainly chromatographic techniques are often combined with spectroscopic techniques. In chromatography, the pure or nearly pure fractions of chemical components in a mixture are separated and submitted to spectroscopic estimation, thereby producing selective information leading to identification using standards or library spectra. The term "hyphenated technique" ranges from the combination of separation-separation, separation-identification and identification-identification techniques. The term "hyphenation" was first coined in 1980 by Hirschfeld [1] to describe the combination of two or more instrumental analysis methods on a single platform. The aim of the coupling is to obtain both identification and quantification detected in a more informative manner, as compared to that with a single analytical technique. Hyphenated techniques offer various advantages over single techniques like fast, accurate analysis under a high degree of automation with high sample throughput leading to better reproducibility, shorter analysis time, etc. A good number of reviews on the topic have appeared in the literature. In 2008, we comprehensively reviewed various hyphenated techniques [2]. This review has been cited regularly, emphasizing the impor-

tance of the topic. In 2010, Patel., *et al*. reviewed the applications of hyphenated techniques [4], followed by reviews by Joshi., *et al*. in 2012 [5], Nagajyothi., *et al*. in 2017 [6] and Meena., *et al*. in 2019 [7].

Hyphenated techniques offer many advantages over any single standalone analytical method. By coupling two or more techniques, we can combine their advantages leading to improved analytical information, as compared to any of the individual techniques alone.

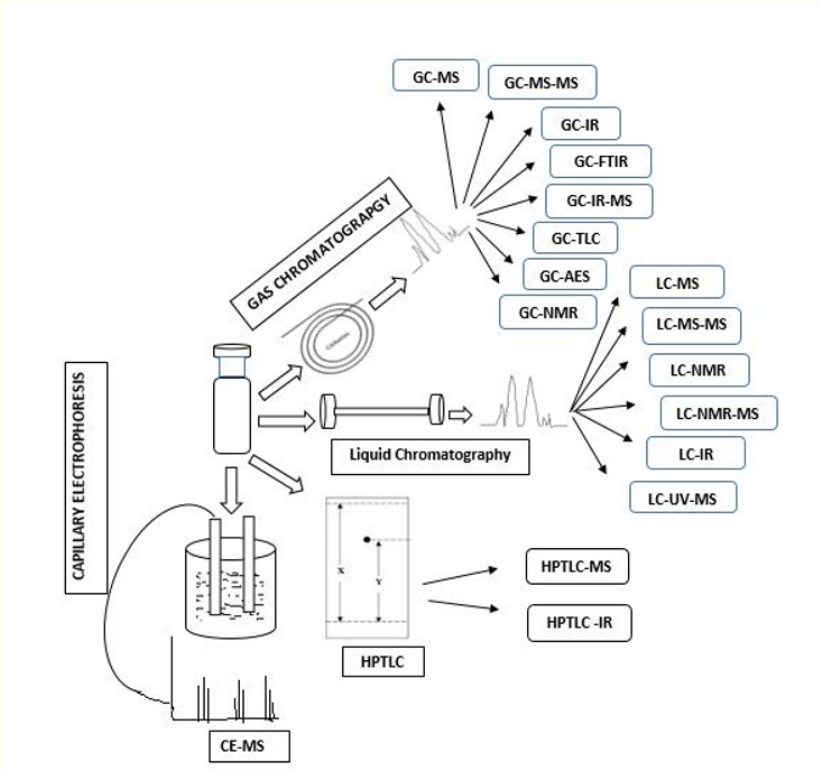


***Figure 1:*** *A pictorial overview of hyphenated analytical techniques in practice.*

1. When a good qualitative technique is coupled with a good quantitative technique, both techniques complement each other. For e.g. GC's excellent quantitative but poor qualitative analysis is complimented by the good qualitative and poor quantitative analysis of either IR or MS.
2. Second advantage is the high sample throughput. For e.g. GC-MS, can separate almost a thousand of individual compounds in one working shift.
3. The results produced are more fast, accurate and re-producible as compared to a single technique.
4. High degree of automation has also been achieved with the introduction of hyphenated techniques, thereby reducing manual errors.

An overview of the various permutations-combinations that are involved in various hyphenated analytical techniques in practice is depicted in figure 1.

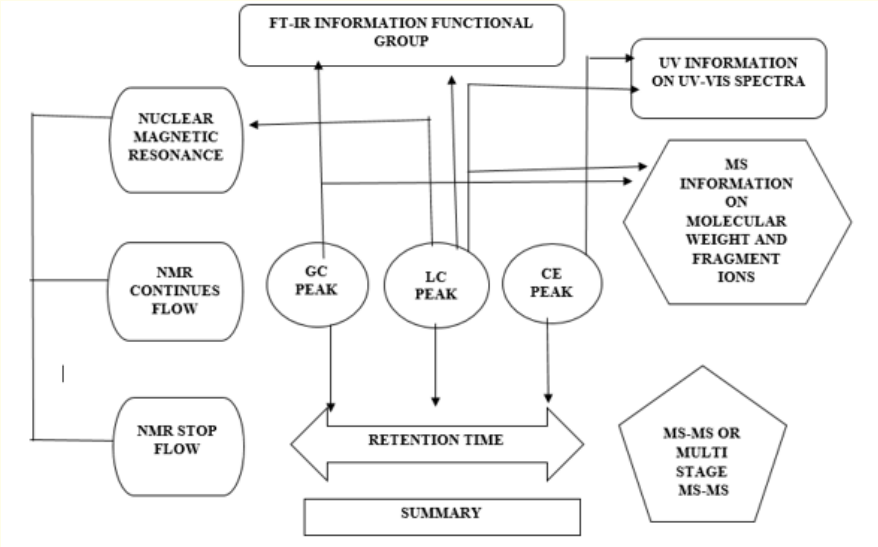


***Figure 2:*** *Summary of hyphenated techniques.*

Hyphenated technique is a combination of two analytical techniques, as shown in figure 2, wherein generally, a separation technique is combined with an identification technique. A lot of information can be obtained by combining two or more techniques. These hyphenated techniques offer shorter analysis time, a higher degree of automation, higher sample throughput.

## Conclusion

Hyphenated analytical techniques have been used for various analytical applications in different fields of science and are not restricted to the field of pharmaceutical analysis.

## Bibliography

1. Hirschfeld T. "The hyphenated methods". *Analytical Chemistry* 52.2 (1980): 297 A-312.
2. Jain KS., *et al*. "A Review on Hyphenated Analytical Techniques". *Current Analytical Chemistry* 18 (2022): 956-976.
3. Jain KS., *et al*. "Hyphenated techniques in analytical world". *Indian Journal of Pharmaceutical Education and Research* 42.4 (2008): 393-401.
4. Patel KN., *et al*. "Hyphenated techniques and their applications in Pharmacy". *Pharmaceutical Methods* 2.1 (2010): 1-13.
5. Joshi RR., *et al*. "Hyphenated technique- a boon to analytical world". *International Journal of Pharmacy and Pharmaceutical Sciences* 3.11 (2022): 4184-4191.
6. Nagajyothi S., *et al*. "Hyphenated techniques- A comprehensive review". *International Journal of Advanced Research and Development* 2.4 (2017): 63-71.

7. Meena PL., *et al*. "A review of singular and hyphenated analytical techniques in trace element analysis". *Chemistry Research Journal* 4.1 (2019): 117-124.

**Volume 11 Issue 4 April 2023**