

Review Article on HPLC & Gas Chromatography

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Abstract: *Two of the most potent and popular analytical separation methods in contemporary pharmaceutical, biomedical, environmental, and food-quality testing are high-performance liquid chromatography (HPLC) and gas chromatography (GC). For the qualitative and quantitative assessment of complicated mixes, both methods offer excellent sensitivity, accuracy, and repeatability. For the examination of thermally labile, non-volatile, polar, and high-molecular-weight chemicals, HPLC has developed into a vital instrument. Different stationary phases, detectors, and elution techniques increase its adaptability and allow for high-resolution separation of multi-component systems. Speed, selectivity, and detection limits have been greatly enhanced by innovations like UHPLC, monolithic columns, core-shell particles, and hyphenated techniques (LC–MS, LC–NMR). On the other hand, gas chromatography is very effective for volatile and semi-volatile substances because it uses inert carrier gases, exact temperature control, and sophisticated detectors like FID, ECD, and MS. Its use in toxicology, forensics, petroleum analysis, and environmental monitoring has increased thanks to innovations like GC–MS/MS, rapid GC, multidimensional GC (GC×GC), and enhanced micro-injection systems. The principles, instrumentation, sample preparation requirements, applications, and recent developments of both approaches are thoroughly compared in this review article. Their analytical performance factors, method development considerations, validation aspects, and applicability for particular analyte classes are highlighted.*

Keywords: High-Performance Liquid Chromatography (HPLC), Gas Chromatography (GC), Chromatographic Separation, Analytical Techniques, Method Development, Validation, Detection Systems, Hyphenated Techniques, UHPLC, GC–MS

