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Commentary

# Advances in Reversed Phase-High Performance Liquid Chromatography

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## DESCRIPTION

HPLC is the most widely utilized method of analysis for medicinal formulations. Indeed, it is the most important technique used in the quality control of bulk drugs and pharmaceutical formulations as well as the detection of drugs and metabolites in biological samples. The Reversed-Phase (RP) mode, which uses a hydrophobic stationary phase and a polar mobile phase, is used in the majority of pharmaceutical laboratory HPLC procedures. The ultraviolet (UV)/Visible detector is the most used detection mode in quality control. As a result, mobile phase compatibility with this detection is a factor that is frequently considered during the design of the pharmacological analysis.

Water (with additions to alter pH and ionic strength) and an organic solvent, such as Acetonitrile (ACN) or Methanol (MeOH), make up the mobile phase of RP-HPLC. Because of their unique combination of qualities beneficial for RP-HPLC applications, these two organic solvents are by far the most desired organic solvents utilized in RP-HPLC. Complete miscibility with water, low viscosity of their aqueous solutions (especially in the case of ACN), low UV cut-off wavelength (190 nm and 205 nm for ACN and MeOH, respectively), and availability in the high purity required for HPLC, and low chemical reactivity with most sample species, as well as with HPLC instrument and column surfaces.

Despite their remarkable properties, ACN and MeOH have certain environmental and health concerns. ACN is combustible, volatile, and poisonous. Despite the fact that MeOH is less toxic and more quickly biodegradable than ACN, it is nonetheless classified as a hazardous solvent due to its intrinsic toxicity and the high waste disposal requirements. The quantity of waste created by RP-HPLC tests, however, cannot be ignored. In reality, a continuous liquid chromatograph with a standard LC column (15-25 cm length, 4.6 mm i.d., packed with 5 m particles) and a mobile phase flow rate of 1 ml/min produces around 1.5 L of waste per day, or about 500 L of effluent per year.

Furthermore, due to technical advancements that enable high-throughput analysis, the use of HPLC is becoming more and more widespread, resulting in an increase in waste production. Concerns about the health and environmental effects of organic solvents widely employed in RP-HPLC have sparked a lot of interest in the analytical community, which is exploring for novel options to replace polluting analytical procedures with cleaner ones.

In the 2000s, Green Analytical Chemistry (GAC) originated from green chemistry, and it has earned increasing attention and recognition among scientists. Its approach entails removing or lowering harmful substances from analytical procedures in order to promote environmental and health friendly while retaining method performance. Some ways are often used to produce greener liquid chromatography procedures based on the 12 principles of green chemistry. They focus solely on reducing solvent consumption by reducing column length, internal diameter, and/or column particle size; replacing toxic and hazardous solvents like ACN and MeOH with less toxic and environmentally friendly alternatives; and emphasising recycling in larger-scale preparative separation technologies. Because certain tactics for greening chromatographic methods are more effective than others, evaluation tools to measure the greenness of analytical methods are required. NEMI labelling and analytical Eco-scale approaches are two of the most well-known technologies that have previously been developed. If hazardous or corrosive chemicals are utilized, or if the method creates considerable volumes of waste, NEMI labelling produces an easy-to-read pictogram. The analytical Eco-scale is a more quantitative technique that involves deducting penalty points from a total of 100 depending on reagent quantity and danger, energy consumption, occupational risks, and waste generated.

## CONCLUSION

Several studies have been published in recent years on the use of GAC concepts to chromatography analysis in general, with some focusing on pharmaceutical analysis specifically. Because eliminating the use of organic solvents in RP-HPLC is impossible, the best method to make this technology greener is to replace dangerous solvents with safer alternatives. Solvent-reduction measures can also be used to make a procedure more environmentally friendly. However, reducing the quantity of solvent utilized and, as a result, the waste created frequently necessitates the procurement of costly Ultra-High-Performance Liquid Chromatography (UHPLC) apparatus or the development of new technologies.

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