IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 5, April 2025
Impact Factor: 7.67

Role of RP-HPLC in Pharmacokinetics and Bioavailability Studies: Current Trends

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Abstract: *Reverse Phase High-Performance Liquid Chromatography (RP-HPLC) has emerged as a gold standard analytical technique in pharmacokinetic and bioavailability studies due to its high resolution, reproducibility, and versatility. It plays a pivotal role in quantifying drugs and their metabolites, determining pharmacokinetic parameters (Cmax, Tmax, AUC, half-life, clearance), and assessing absolute and relative bioavailability. Recent advancements, such as ultra-fast UPLC, core-shell columns, and LC-MS/MS integration, have significantly improved the sensitivity, selectivity, and efficiency of drug analysis. However, challenges remain, including matrix interferences, limited detection capabilities for low-dose drugs, and labor-intensive sample preparation. While RP-HPLC remains widely used, alternative techniques such as LC-MS/MS and Capillary Electrophoresis (CE) offer superior sensitivity and automation. Green chromatography approaches and AI-driven data processing are shaping the future of RP-HPLC, ensuring faster, more sustainable, and highly accurate bioanalytical studies. This review discusses the fundamental principles, applications, recent innovations, challenges, and future prospects of RP-HPLC in pharmacokinetic and bioavailability research..*

Keywords: RP-HPLC, Pharmacokinetics, Bioavailability, LC-MS/MS, UPLC, Drug Metabolism, Green Chromatography, Analytical Validation

DOI: 10.48175/568