

# Advances, Applications, and Challenges in RP HPLC Method Development

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**Abstract:** High-performance liquid chromatography (HPLC) has become an indispensable tool for modern analytical chemistry, and reversed-phase (RP) HPLC is one of the most widely used techniques for the separation and analysis of complex mixtures. In recent years, there have been numerous advances in RP HPLC method development, including the development of new stationary phases, improved column technology, and novel optimization strategies. These advances have led to increased speed, resolution, and sensitivity, as well as improved selectivity and reduced non-specific adsorption. Moreover, RP HPLC has found applications in a wide range of industries, including pharmaceuticals, food and beverage, environmental analysis, forensic science, and biotechnology. Despite its many benefits, RP HPLC method development is not without its challenges, including issues with column stability, sample preparation, and optimization. In this review article, we provide a comprehensive overview of the principles, optimization strategies, and recent advances in RP HPLC method development. We discuss the applications of RP HPLC in various industries and identify the common challenges and emerging trends in the field. Additionally, we evaluate the impact of RP HPLC on the accuracy, sensitivity, and selectivity of analysis and its potential to improve the quality and safety of products and the environment. Overall, this review highlights the importance of RP HPLC in modern analytical chemistry and provides insights and recommendations for researchers and practitioners who are interested in this technique. By exploring the latest advances, applications, and challenges in RP HPLC method development, we hope to inspire continued innovation and progress in this important field.

**Keywords:** RP HPLC, method development, optimization, stationary phase, mobile phase, UHPLC, 2D-LC, pharmaceutical, food and beverage

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