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Short communication

Validation of dissolution method for Cefalexin capsules 500mg and comparation between UV/VIS spectrophotometric and HPLC method

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Introduction

Dissolution testing represents one of the critical quality control parameters for solid oral dosage forms, providing essential information regarding the rate and extent of active pharmaceutical ingredient (API) release under defined conditions (Ph. Eur., 2023; USP <711>, 2023). The routine analytical procedure previously applied for dissolution testing of Cefalexin capsules 500 mg was based on UV/VIS spectrophotometric determination. However, the presence of colored gelatin capsule shells resulted in significant analytical interference during absorbance measurements at the selected wavelength, requiring additional correction through analysis of empty capsule shells. The percentage of released active substance was determined by subtraction of the absorbance of the empty capsule from the absorbance of the test solution.

The aim of this study was to develop and validate an HPLC dissolution method for Cefalexin capsules 500 mg in compliance with ICH Q2 (R2) guideline requirements and to perform a comparative evaluation against the previously applied UV/VIS spectrophotometric method for routine pharmaceutical quality control application (ICH, 2023).

Materials and methods

Materials

Cefalexin monohydrate reference standard (RS), glacial acetic acid (Merck, Darmstadt, Germany), dimethyl isosorbide (Sigma-Aldrich, St. Louis, MO, USA), and purified water were used throughout the study. All reagents and chemicals were of HPLC analytical grade.

Dissolution conditions

Dissolution testing was performed using Apparatus 1 (basket apparatus) according to Ph. Eur. 2.9.3 and USP <711> requirements (Ph. Eur., 2023; USP <711>, 2023) Six capsules were tested individually

HPLC method

The HPLC method was performed using a mobile phase consisting of 0.5% (*v/v*) aqueous acetic acid solution and dimethyl isosorbide in ratio 90:10 with UV detection at 254 nm. Dimethyl isosorbide was selected as a greener solvent alternative to conventionally used organic modifiers such as acetonitrile or methanol.

Validation procedure

Method validation was performed according to

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internal guidelines for validation of analytical procedures in compliance with ICH Q2(R2) requirements. The following validation parameters were evaluated: specificity, linearity and range, accuracy, precision, robustness, filter recovery study and stability of solutions (ICH, 2023).

Results and discussion

System suitability testing confirmed adequate chromatographic performance prior to analysis, with all parameters meeting predefined acceptance criteria for peak symmetry, repeatability, and theoretical plates, indicating suitability of the system for routine use. Specificity testing demonstrated that diluent, placebo matrix, and capsule shell components did not interfere with the Cefalexin peak. The HPLC method ensured clear separation of the active substance from all potential interfering components, confirming high selectivity of the method. In comparison with the UV/VIS spectrophotometric method, the HPLC approach eliminated interference from the colored capsule shell and removed the need for correction using empty capsule analysis. This significantly improved analytical reliability and reduced method complexity, providing more robust quantification of Cefalexin in dissolution samples. Linearity was confirmed over the range of 25%–130% of the target concentration, demonstrating proportional response throughout the investigated interval. Accuracy studies based on recovery experiments confirmed acceptable trueness across all tested levels. Precision, including system, method, and intermediate precision, demonstrated consistent results with low variability under different analytical conditions, analysts, instruments, and days, confirming high reproducibility of the method. Robustness evaluation using Plackett-Burman design showed that small deliberate changes in chromatographic parameters did not significantly affect method performance. Flow rate and column usage were identified as the most influential factors, but all responses remained within acceptance criteria. Stability studies confirmed that standard and sample solutions remained stable under evaluated conditions, while filter recovery tests demonstrated no significant effect of filtration on analytical results. From an environmental perspective, the use of dimethyl isosorbide as a green solvent represents a significant advantage, reducing reliance on conventional hazardous organic solvents and supporting sustainable analytical practice in pharmaceutical laboratories (Damjanoska et al., 2025).

Conclusion

Compared with the previously applied UV/VIS spectrophotometric method, the developed HPLC procedure provides substantially improved analytical specificity and selectivity through chromatographic separation of Cefalexin from interfering sample components. The method additionally eliminates the need for absorbance correction through analysis of empty capsule shells, thereby simplifying analytical workflow and reducing potential sources of analytical variability. Furthermore, the use of a mobile phase composed of 0.5% acetic acid and dimethyl isosorbide (DMI) represents a green analytical approach, contributing to a reduced environmental footprint through the application of eco-friendly solvents.The validated HPLC method for determination of the dissolution rate of Cefalexin in Cefalexin capsules 500 mg has been demonstrated to be specific, linear, accurate, precise, robust, and suitable for its intended analytical purpose in accordance with internal validation requirements and ICH Q2 (R2) guideline expectations. Additionally, a filter recovery study was performed and the stability of both the standard and sample solution was evaluated. Therefore, the validated HPLC method is considered suitable for routine quality control analysis and dissolution profiling of Cefalexin capsules 500 mg.

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