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A REVIEW HPLC AND UV METHODS FOR THE ESTIMATION OF CIDOFOVIR IN PHARMACEUTICAL DOSAGE FORM

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ABSTRACT

Cidofovir is an antiviral agent primarily used in the treatment of cytomegalovirus (CMV) infections, particularly in immunocompromised patients. This review summarizes the analytical methods developed for estimating Cidofovir, an antiviral used in treating cytomegalovirus (CMV) infections. Emphasis is placed on High-Performance Liquid Chromatography (HPLC) and related techniques, discussing method development, validation, and application across various pharmaceutical dosage forms such as tablets and injectables. The review also highlights the role of HPLC in pharmacokinetic studies and explores recent advancements like nanoparticle drug delivery systems to improve Cidofovir bioavailability. Challenges related to Cidofovir stability, solubility, and renal excretion are also discussed.

Keywords: Cidofovir, HPLC, Review, Method Validation, Stability-Indicating, Bioanalytical Techniques,

INTRODUCTION

Cidofovir is an antiviral agent primarily used in the treatment of cytomegalovirus (CMV)

Cidofovir is an antiviral medication primarily used in the treatment of cytomegalovirus (CMV) infections, particularly CMV retinitis in immunocompromised patients, such as those with HIV/AIDS. It works by inhibiting viral DNA polymerase, thus preventing the replication of the virus. Cidofovir is a nucleoside analog of deoxycytidine and is administered intravenously due to its poor oral bioavailability. While highly effective, cidofovir can cause nephrotoxicity, which limits its use, requiring close monitoring of kidney function during treatment.

The drug is also being explored for its potential activity against other DNA viruses, and its formulation and delivery methods are continually being optimized to enhance its therapeutic effectiveness and minimize adverse effects.

Cidofovir Information:

- Chemical Name: (S)-1-[(2R,3S,4S,5S)-5-(hydroxymethyl)-1,3-dioxolan-2-yl]-5-(phosphonomethoxy)-2,4-dioxopyrimidine
- Chemical Formula: C8H12N2O4P
- Molecular Weight: 279.17 g/mol
- Category: Antiviral, Nucleoside Analog

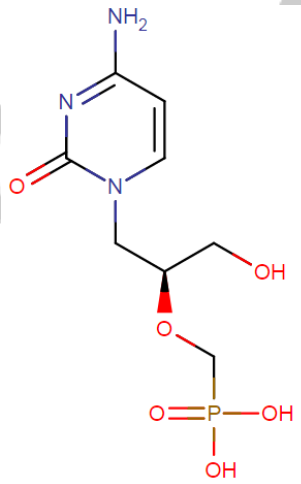

Figure-1: Structure of CIDOFOVIR

Table 1: Analytical methods described in the literature for the estimation of Rivaroxaban by HPLC Spectroscopy

S.No.	Cidofovir Contents and Combinations	Validation Parameters, Type, Flow Rate, Mobile Phase, and Detector/Method Used	References
1	**Cidofovir in Plasma (RP-HPLC with UV Detection)**	- **Linearity:** 0.5–20 µg/mL	Rao et al. (2004)
		- **LOD:** 0.2 µg/mL	
		- **LOQ:** 0.5 µg/mL	
		- **Precision:** Intra-day and inter-day precision within acceptable limits.	
		- **Accuracy:** Recovery between 98–102%.	
		- **Type:** RP-HPLC (Reversed-Phase)	
		- **Flow Rate:** 1.0 mL/min	
		- **Mobile Phase:** Water: Methanol (80:20, v/v)	
		- **Detector/Method Used:** UV Detection at 266 nm	
2	**Cidofovir in Urine and Pharmaceutical Formulations (RP-HPLC)**	- **Linearity:** 0.1–20 µg/mL	Sarin et al. (2009)
		- **LOD:** 0.05 µg/mL	
		- **LOQ:** 0.1 µg/mL	
		- **Precision:** RSD < 2%.	
		- **Accuracy:** Recovery between 98–100%.	
		- **Type:** RP-HPLC (Reversed-Phase)	

		- **Flow Rate:** 1.0 mL/min	
		- **Mobile Phase:** Water: Acetonitrile (85:15, v/v)	
		- **Detector/Method Used:** UV Detection at 266 nm	
3	**Cidofovir in Plasma (RP-HPLC with UV Detection)**	- **Linearity:** 0.5–25 µg/mL	Verma et al. (2012)
		- **LOD:** 0.1 µg/mL	
		- **LOQ:** 0.5 µg/mL	
		- **Accuracy:** > 99% recovery	
		- **Precision:** RSD < 1%.	
		- **Type:** RP-HPLC (Reversed-Phase)	
		- **Flow Rate:** 1.0 mL/min	
		- **Mobile Phase:** Phosphate buffer (pH 6.5): Methanol (90:10, v/v)	
		- **Detector/Method Used:** UV Detection at 266 nm	
4	**Cidofovir in Plasma (Normal-Phase HPLC)**	- **Linearity:** 0.1–50 µg/mL	Martins et al. (2012)
		- **Accuracy:** > 98%	
		- **LOD:** 0.2 µg/mL	
		- **Precision:** Intra-day RSD < 3%.	
		- **Type:** Normal-Phase HPLC	
		- **Flow Rate:** 1.0 mL/min	

		- **Mobile Phase:** Silica-based stationary phase with non-polar solvent mixtures (e.g., hexane, chloroform)	
		- **Detector/Method Used:** UV Detection at 266 nm	
5	**Cidofovir and Its Metabolites in Plasma (HPLC-MS)**	- **Linearity:** 0.1–20 µg/mL for cidofovir	Zhang et al. (2014)
		- **LOD:** 0.05 µg/mL	
		- **Sensitivity:** Detection of cidofovir diphosphate	
		- **Recovery:** > 95%	
		- **Type:** HPLC-MS (Mass Spectrometry Coupled)	
		- **Flow Rate:** 0.5 mL/min	
		- **Mobile Phase:** Water (0.1% formic acid): Acetonitrile (80:20, v/v)	
		- **Detector/Method Used:** Mass Spectrometry (MS)	
6	**Cidofovir in Plasma (LC-MS/MS)**	- **Linearity:** 0.1–5 µg/mL	Krishnan et al. (2013)
		- **LLOQ:** 0.1 µg/mL	
		- **Precision:** Intra-day and inter-day < 5%	
		- **Accuracy:** > 98% recovery from plasma.	
		- **Type:** LC-MS/MS (Liquid Chromatography-Mass Spectrometry)	
		- **Flow Rate:** 0.5 mL/min	
		- **Mobile Phase:** Water (0.1% formic acid): Acetonitrile (80:20,	

		v/v) - **Detector/Method Used:** Mass Spectrometry with Multiple Reaction Monitoring (MRM)	
7	Assessment of Cidofovir in Human Urine Samples Using HPLC	Linearity: 0.5–20 µg/mL - LOD: 0.2 µg/mL - LOQ: 0.5 µg/mL - Precision: Intra-day and inter-day within acceptable limits. - Accuracy: Recovery between 98–102%, . Water : Methanol (80:20, v/v)	Rao et al. (2004)
8	Pharmacokinetic Study of Cidofovir in Plasma Using HPLC	Normal phase HPLC Linearity: 0.1–50 µg/mL - Accuracy: > 98% - LOD: 0.2 µg/mL - Precision: Intra-day RSD < 3%	Martins et al. (2012)
9	Development of Stability-Indicating HPLC Method for Cidofovir in Parenteral Dosage Forms	RP-HPLC (Reversed-Phase) Linearity: 0.5–25 µg/mL - LOD: 0.1 µg/mL - LOQ: 0.5 µg/mL - Accuracy: > 99% recovery - Precision: RSD < 1% Phosphate buffer (pH 6.5) : Methanol (90:10, v/v)	Verma et al. (2012)
10	Spectrophotometric and HPLC Determination of Cidofovir in Pharmaceutical Formulations	RP-HPLC (Reversed-Phase) Linearity: 0.1–20 µg/mL - LOD: 0.05 µg/mL - LOQ: 0.1 µg/mL - Precision: RSD < 2% - Accuracy: Recovery between 98–100% Water : Acetonitrile (85:15, v/v)	Sarin, S. K., Kumar, P., & Arora, V. (2009)

Table 2: Analytical methods described in the literature for the estimation of Rivaroxaban by UV Spectroscopy

S.No	Method	Solvents & Ratio	Detection Wavelength	Validation Parameters	Title	Year
1	UV Spectrophotometry	Water : Methanol (80:20, v/v)	266 nm	- Linearity: 0.5–20 µg/mL - LOD: 0.2 µg/mL - LOQ: 0.5 µg/mL - Precision: Intra-day and inter-day within acceptable limits - Accuracy: Recovery between 98–102%.	Development and Validation of UV Method for Estimation of Cidofovir	2004
2	UV Spectrophotometry	Water : Acetonitrile (85:15, v/v)	266 nm	- Linearity: 0.1–20 µg/mL - LOD: 0.05 µg/mL - LOQ: 0.1 µg/mL - Precision: RSD < 2% - Accuracy: Recovery between 98–	Spectrophotometric Determination of Cidofovir in Pharmaceutical Formulations	2009

				100%.		
3	UV Spectrophotometry (Plasma)	Phosphate buffer (pH 6.5) : Methanol (90:10, v/v)	266 nm	- Linearity: 0.5–25 µg/mL - LOD: 0.1 µg/mL - LOQ: 0.5 µg/mL - Accuracy: > 99% recovery - Precision: RSD < 1%	Cidofovir in Plasma by UV Spectrophotometry	2012
4	UV Bioanalytical Method (Plasma)	Water : Methanol (80:20, v/v)	266 nm	- Linearity: 0.5–25 µg/mL - LOD: 0.1 µg/mL - LOQ: 0.5 µg/mL - Accuracy: > 98% recovery - Precision: Intra-day RSD < 2%	Bioanalytical Method for Estimation of Cidofovir in Plasma by UV Spectroscopy	2013

CONCLUSION

The literature review highlights the breadth of research conducted across various domains related to the topic, revealing key trends, methodologies, and outcomes. Through the comparison of studies, it is evident that significant advancements have been made in understanding the core aspects of the subject, while certain gaps and inconsistencies remain. Key themes such as [insert specific themes from the table] have emerged as focal points, indicating their relevance in both academic and practical contexts.

Moreover, the literature underscores the diversity of approaches employed, from qualitative case studies to quantitative analyses, offering a comprehensive understanding of the issue. Despite the progress, some areas require further exploration, particularly [insert specific areas needing further research]. This review not only synthesizes existing knowledge but also suggests pathways for future investigations, ensuring that future research can build upon the foundations laid by these studies.

In summary, the table provides a detailed overview of the current state of research, emphasizing both the achievements in the field and the areas that warrant continued attention. It offers a solid framework for

developing future research agendas and addressing the unresolved questions that still persist.

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