A Study on UV Spectrophotometric Quantification of Famciclovir in Drug Formulations

Deepika Soni[1], Kunal Verma[2]
Student[1], Associate Professor[2]
Department of Pharmaceutics
Bansal College of Pharmacy
Corresponding Author's E-mail: *deepikasoni89@rediffmail.com[1]*

Abstract

A straightforward, swift, precise, and sensitive UV-spectrophotometric method has been developed for the analysis of Famciclovir in pharmaceutical formulations. The methodology utilizes 0.1 N HCl as the solvent and measures absorbance at 312 nm. The linearity of the substance within the concentration range of 2-12 g/ml is evident with a high correlation coefficient of 0.9978. The recovery rate of the drug falls within the range of 98.62% to 100.5%. The validation of the method complies with ICH criteria. This cost-effective and sensitive approach is applicable for the estimation of Famciclovir in both bulk and tablet dosage forms.

Keywords: *Famciclovir; 0.1 N HCl; UV-spectrophotometric method; ICH guidelines*

INTRODUCTION

2-(2-amino-9H-purin-9-y1) ethyl trimethylene diacetate is the chemical name for famciclovir (Fig-1). It is a new generation antiviral medication that is an acyclic guanine nucleoside analogue. Herpes zoster and genital mucocutaneous herpes are treated with this next generation antiviral medication, which is taken orally. The antiviral agent penciclovir has a prodrug called famciclovir. It has the chemical formula C14H19N5O4 and a molecular weight of 321.3 g/mol. It dissolves completely in acetone and methanol, but only sparingly in ethanol and isopropanol. It's a solid that ranges from white to pale yellow in colour. It's sold as a white tablet with a film coating.

The shape of the 125 mg and 250 mg tablets is round, while the oval shape of the 500 mg tablets is oval. hydroxypropyl cellulose, hydroxypropyl methylcellulose, lactose, magnesium stearate, polyethylene glycols, sodium starch glycolate, and titanium dioxide are among the inactive components. Given the widespread usage of famciclovir in antiviral therapy, it's critical to develop and validate analytical methods for determining its concentration in pharmaceutical dosage forms. Spectrophophotometry [1-4] and RP-HPLC [5-7] are two analytical methods published for estimating Famciclovir in API, pharmaceutical dosage form, and biological fluid, according to a literature review.

HPLC and LC-MS are expensive analytical procedures that aren't readily available in every lab. As a result, the spectrophotometric approach [8-15] is a viable alternative, with UV spectrophotometric methods [8-15] being frequently employed due to its low cost and accessibility. The authors of this paper seek to create and validate a simple, quick, and sensitive zero order UV spectrophotometric method for estimating Famciclovir in API and pharmaceutical formulations. The developed method has been validated in accordance with the ICH recommendations [16], and the results have been statistically interpreted.

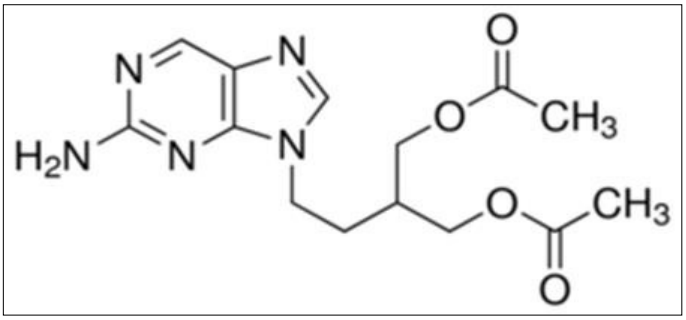

Figure 1 Structure of Famciclovir

MATERIAL AND METHODS

Instrumentation

The ELICO (Hyderabad, India) twin beam model SL 244 UV/VISIBLE Spectrophotometer was used for all of the absorbance and spectrum observations. For the absorbance measurements, one cm matched quartz cells were employed. An LI 1120 was used to take the pH readings (Elico, India). All weighing was done on an AUX220 (Shimadzu, Japan). For solublization, an ultra sonicator (Citizen ultra sonicator) was employed.

Reagents and materials

The raw ingredient for famciclovir was supplied from Yarrow Chem. Products in Mumbai, India. SD Fine Chemicals provided analytical grade hydrochloric acid. VIROVIR (FDC Limited, India) tablet formulation containing Famciclovir 500 mg was acquired from a local pharmacy. Analytical grade reagents and solvents were utilised throughout. A water purification equipment provided double distilled water.

Preparation of standard solution

Weighing 10 mg of Famciclovir pure, diluted with a small amount of 0.1 N HCl, and placed into a 10 ml volumetric flask yielded a standard stock solution. 0.1N HCl was used to bring the volume up to the required level. This solution yields a Famciclovir concentration of 1000 g/mL. By diluting the stock solution with 0.1 N HCl, a working standard solution corresponding to 100 g/ ml of Famciclovir was achieved.

Preparation of working standard solution

To get a concentration of 4 g/ml, 0.4 ml of the standard stock solution was transferred to a 10 ml volumetric flask and diluted to 10 ml with 0.1 N HCl. Famciclovir standard solution was scanned between 200 and 400 nm. The greatest wavelength exhibited by Famciclovir was 312 nm (Fig.2).

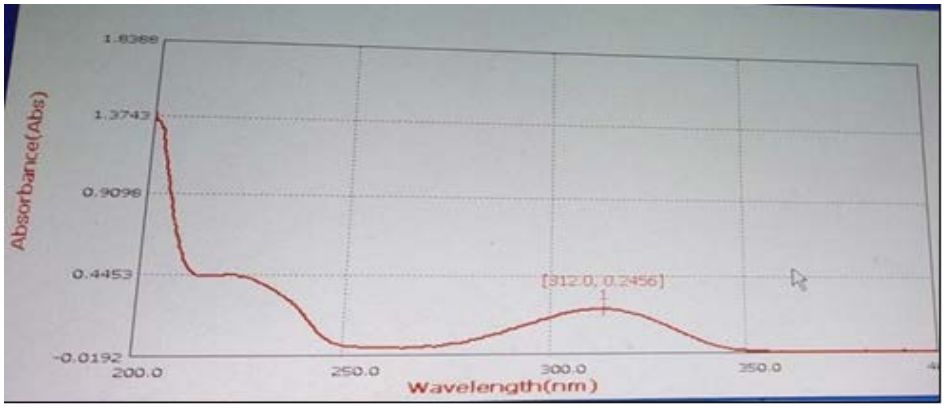

Figure 2 UV spectra of Famciclovir

Procedure for Calibration Curve

A suitable amount (0.2-1.2 ml) of standard stock solution was transferred to a volumetric flask with a capacity of 10 ml. With 0.1 N HCl, the volume was adjusted to the mark, yielding solution concentrations of 2-12 g/ml. At 312 nm, the absorbance of these solutions

was measured against 0.1 N HCl as a blank. By graphing absorbance vs concentrations, a calibration curve was created. This calibration curve yielded a linear regression equation.

Procedure for Pharmaceutical Formulation

The average weight of ten tablets (VIROVIR) was computed. In a mortar and pestle, the tablets were triturated to a fine powder. 10 mg Famciclovir tablet powder was carefully weighed and placed to a 100 mL volumetric flask. 60 mL of 0.1 N HCl was added to this and sonicated for 10 minutes. The flask was shaken, and 0.1 N HCl was added to bring the volume up to the desired level. Whatmann filter paper No.41 was used to filter the aforementioned solution. A total of 0.6 mL of the aforesaid solution was transferred to a 10 mL volumetric flask. With 0.1 N HCl, the volume was brought up to the mark, yielding a solution containing 6 g/ml. The calibration curve was used to determine the tablet's content.

RESULTS AND DISCUSSION

Method Validation

Linearity, precision, accuracy, Limit of detection (LOD) and Limit of Quantitation (LOQ), robustness, and ruggedness were all tested for the created approach.

Linearity

For Famciclovir, a six-point calibration curve was obtained in a concentration range of 2-12 g/ml. The drug's reaction was found to be linear in the concentration range studied, with the linear regression equation y=0.0575x+0.0005 and a correlation coefficient of 0.9978. (Table 1 and 2, Fig. 3).

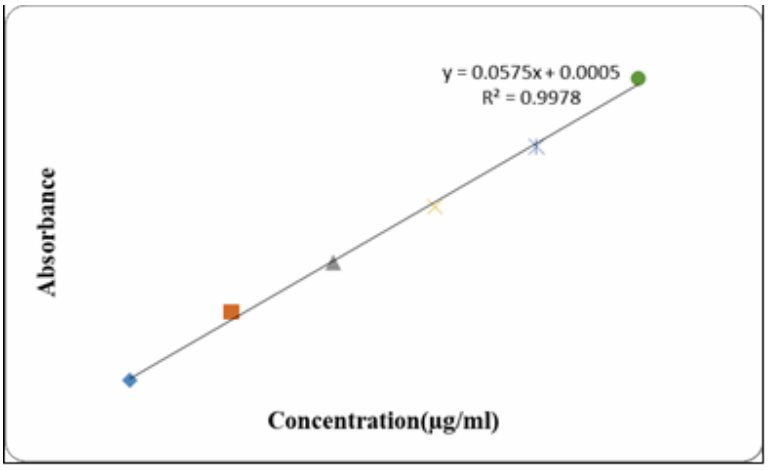

Figure 3 Calibration curve of Famciclovir

Table 1 Linearity Data for Famciclovir

S. No	Concentration (µg/ml)	Absorbance
1	2	0.112
2	4	0.245
3	6	0.342
4	8	0.451
5	10	0.568
6	12	0.702

Table 2 Optical Characteristics of Famciclovir

S. No	Parameters	Method
1	λmax (nm)	312
2	Beers law limit (µg/ml)	2-12
3	Sandell's sensitivity (µg/cm^2/0.001 A.U)	0.0034
4	Molar absorptivity (L mol^{-1} cm^{-1})	2.5 x 10^4
5	Correlation coefficient (r)	0.9978
6	Regression equation(Y=mX+c)	Y=0.0575X+0.0005
7	Slope(m)	0.0575
8	Intercept(c)	0.0005
9	LOD (µg/ml)	0.14
10	LOQ (µg/ml)	0.44
11	Standard error of mean of Regression line	0.00294

Precision

Precision was tested for repeatability, interday precision, and intraday precision. It was calculated as a percentage RSD.

Repeatability

Six times the sample solution prepared for the assay determination was tested for repeatability. RSD was calculated as a percentage (Table 3).

Table 3 Repeatability

Concentration(µg/ml)	Absorbance
6	0.341
6	0.345
6	0.344
6	0.343
6	0.345

6	0.345
Mean	0.343
Standard Deviation	0.0016
% RSD	0.466

Interday and Intraday precision

Famciclovir intraday and interday precision studies were conducted by estimating different concentrations of Famciclovir six times on the same day (intraday precision) and on different days (interday precision), with the findings provided in percentage RSD (Table 4). The devised approach was shown to be precise, with average percent RSD values of 1.68 percent and 1.51 percent for intraday and interday precision studies, respectively (Table 4).

Table 4 Results for precision

Precision	**Intraday**		**Interday**	
	Morning	**Evening**	**Day 1**	**Day 2**
Mean (n=6)	0.342	0.346	0.332	0.347
SD	0.007305	0.006735	0.007305	0.006802
RSD	0.016878	0.015096	0.016878	0.015194
%RSD	1.68	1.50	1.68	1.51

Accuracy

The method's accuracy was determined by adding a known amount of standard medication to a known amount of marketed formulation at three distinct concentration levels of 80, 100, and 120 percent, taking into account the percentage purity of the added bulk drug samples. The average recoveries were calculated after three analyses of each concentration (Table 5). The recovery investigation showed that the established method is an accurate approach for determining Famciclovir, with results ranging from 92.62 percent to 100.5 percent. Table 3 shows a summary of the findings.

Table 5 Results for Accuracy

Recovery level (%)	**Concentration (µg/ml)**		**%Mean Recovery* ± SD**	**%RSD**
	Test Con.	Std. added		
80	6	4.8	99.12 ± 0.99	1.01
100	6	6	99.62 ± 0.28	0.29
120	6	7.2	100.51 ± 0.16	0.17

Robustness

A method's robustness refers to its ability to stay unaffected by minor changes in conditions. The experimental settings were purposefully changed and the assay was analysed to determine the method's robustness. At a wavelength of ±2 nm, the influence of detecting wavelength was investigated. At ± 0.02 N HCl, the effect of changing the solvent strength was investigated. The material was tested in triplicates to account for changes in circumstances. When the effect of changing one set of variables was investigated, the other conditions were kept at their optimal levels. For the suggested approach, the assay for all deliberate changes of circumstances should be between 98.0–102.0 percent (Table 6).

Ruggedness

The suggested method's robustness is determined by two analysts analysing aliquots from a homogeneous slot under the identical operational and environmental settings (Table 7).

Limit of Detection (LOD) and Limit of Quantitation (LOQ)

The LOD and LOQ were calculated according to below equation given by LOD= 3.3 σ/s
LOQ=10 σ/s

Where σ is the standard deviation of y intercepts of regression lines and s is the slope of the calibration curve (Table 2). The low value of LOD and LOQ indicate that the method is sensitive.

Table 6 Robustness Studies

Formulation	**Amount of drug taken from tablet(mg)**	**At 310 nm**	**At 314 nm**
		(n=3) %Assay±%RSD	(n=3) % Assay±%RSD
VIROVIR (Tablets)	500	99.73±0.313	99.91±0.224
		At 0.08 N HCl	**At 0.12 N HCl**
		(n=3)%Assay±%RSD	(n=3)%
		99.32±0.498	99.67±0.602

Table 7 Ruggedness Studies

Formulation	Amount of drug taken from	Analyst 1 (n=3)	Analyst 2 (n=3)%Assay±%RSD
VIROVIR	500	99.83±0.243	99.86±0.324

Application of method to formulation

The proposed was applied to pharmaceutical formulation of Famciclovir (Table 8).

Table 8 Assay of VIROVIR

Formulation	VIROVIR(Tablets)
Labeled Amount(mg)	500
Amount* Obtained(mg)	499.86
%Purity ± SD	99.97%± 0.685

The % purity of Famciclovir presented in the table indicates that there is a good recovery of Famciclovir in tablet formulation by the developed UV spectrophotometric method.

CONCLUSION

Famciclovir in bulk and formulation was estimated using a simple, cost-effective, precise, accurate, and sensitive UV spectrophotometric approach. According to ICH criteria, the devised approach was validated. In the concentration range of 2-12 g/ml, Beer's law was followed. Famciclovir's correlation coefficient (r2) was found to be 0.9978. For Famciclovir, the percent recoveries were found to be between 99.84 and 100.18 percent. Repeatability, intraday, and interday precision were used to determine the precision of the procedure, with a percent RSD of less than 1% indicating precision. Famciclovir's limit of detection was found to be 0.14 g/ml. Famciclovir's limit of quantitation was found to be 0.44 g/ml.

The proposed approach was shown to be simple, accurate, precise, and reproducible, with adequate analyte recovery, and it may be used to analyse Famciclovir bulk and pharmaceutical capsule formulations. Other advantages of these technologies for routine analysis include their quick analysis time and low cost. It has several advantages over existing approaches, including simplicity, speed, and low cost.

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