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Development and validation of UV spectrophotometric method for the estimation of Zidovudine in bulk samples

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Abstract

A simple, sensitive, rapid and accurate UV spectroscopic method has been developed for the estimation of zidovudine in bulk samples. The method is based upon determination of Zidovudine at 266 nm in distilled water. Different analytical performance parameters such as linearity, precision, accuracy, LOD and LOQ were determined according to ICH guidelines. The method was found linear between the ranges of 10-120 µg/ml for Zidovudine. The LOD and LOQ was found to be 6.54µg/ml and 21.79µg/ml respectively. Therefore, the proposed method can be used for the routine analysis of zidovudine in bulk samples in quality control laboratories.

Keywords: UV spectroscopic, zidovudine, linearity, precision, ICH guidelines

Contents

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1. Introduction

Zidovudine (INN) or Azidothymidine (AZT) is a nucleoside analog reverse transcriptase inhibitor (NRTI), a type of antiretroviral drug [1-3]. It is a synthetic drug with pyrimidine nucleoside analogue active against HIV-1, AIDS and pre- AIDS. The chemical name of Zidovudine is 1- (3- azide-2, 3-di deoxy-β-D-ribofuranosyl)-5-methyl Pyrimidin-2, 4 (1H, 3H) – dione. Zidovudine also has been referred to as 3′azido-3′-deoxythymidine. It has a molecular formula of $C_{10}H_{13}N_5O_4$ and a molecular weight of 267.24 g/mol. It has the structural formula as shown in Fig. 1. Zidovudine is a white to beige, odorless, crystalline solid and it is soluble in ethanol (95%), sparingly soluble in water. The drug is officially listed in United States of Pharmacopeia [4]. Several analytical methods that have been reported for the estimation of Zidovudine in biological fluids or pharmaceutical formulations include UV-Visible Spectrophotometry [5-6], High Performance Liquid Chromatography [7-12] and HPTLC [13-14]. The objective of the work is to develop a simple, accurate, precise and economic UV spectrophotometric method for the estimation of Zidovudine in bulk samples. The method is simple, reproducible and statistically valid.

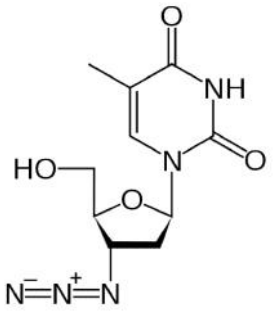

Figure 1. Chemical Structure of zidovudine

2. Materials and Methods

Materials

Zidovudine was obtained as a gift sample from Hetero Drugs Pvt. Ltd, Hyderabad. Distilled water was prepared in-house. PG Instruments T60 UV-Vis Spectrophotometer with a fixed slit width (2 nm) and 10 mm quartz cell was used to obtain spectrum and absorbance measurement.

Standard preparation

10 mg drug was dissolved in distilled water in a 10 ml volumetric flask, the flask was shaken well and the final volume was made up to the mark with the same. From that 0.6 ml was taken and volume was adjusted up to 10 ml with the distilled water to get the final concentration of 60µg/ml.

Selection of analytical concentration ranges

From the standard stock solution I of Zidovudine, appropriate aliquots were pipetted out into 10 ml volumetric flasks and dilutions were made with distilled water to obtain working standard solutions of concentrations from 10 to 120 µg/ml. Absorbance for these solutions were measured at 266 nm and the spectra was shown in Fig. 2. The same solutions were used for the linearity studies.

Method validation

The developed method was validated as per ICH guidelines [15 and 16] Accuracy was determined by recovery studies. The recovery studies were carried out by adding the known amount of standard Zidovudine drug to the sample solution of the tablets. Precision for assay were determined by repeatability, intraday precision for drug (each in three replicate). Ruggedness studies were carried out by changing the analysts. LOD and LOQ were performed and those were values within the limits [17-19].

3. Results and Discussion

Development and optimization of the spectrophotometric method

Proper wave length selection of the methods depends upon the nature of the sample and its solubility. To develop a rugged and suitable spectrophotometric method for the quantitative determination of zidovudine, the analytical condition were selected after testing the different parameters such as water, buffer, buffer concentration, and other spectroscopic conditions. Our preliminary trials were by using different compositions of diluents consisting of water with buffer. But best result was obtained in distilled water and degassed in an ultrasonic bath (Enertech Electronics Private Limited).

Selection of wavelength

Scan standard solution in UV spectrophotometer between 200 nm to 400 nm on spectrum mode, using diluents as a distilled water. Zidovudine shows λ_{max} at 266. The proposed analytical method is simple, accurate and reproducible. The representative spectrum was shown in Fig. 2.

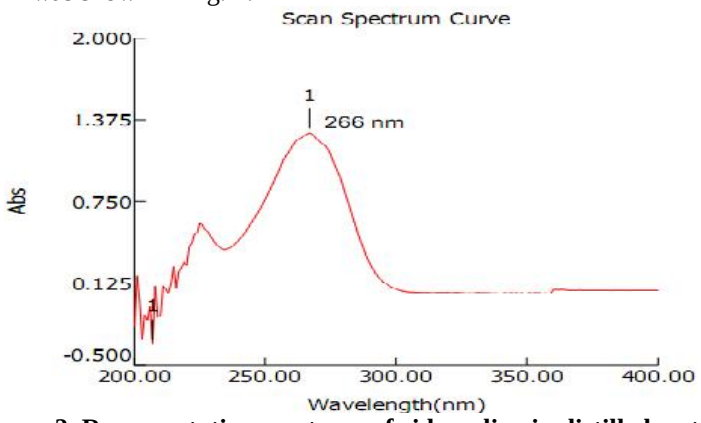

Figure 2. Representative spectrum of ziduvodine in distilled water

Method validation

Linearity

Six points calibration curve were obtained in a concentration range from 10-120 µg/ml for Zidovudine. The response of the drug was found to be linear in the investigation concentration range and the linear regression equation was y = 0.0049x + 0.3877 with correlation coefficient (R^2) 0.9947. The linearity curve was shown in Fig. 3.

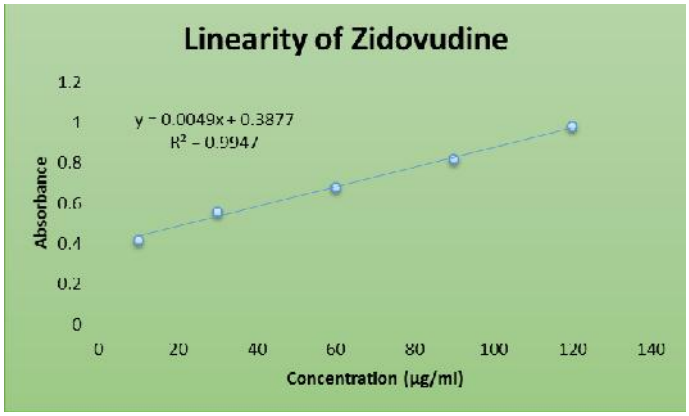

Figure 3. Linearity of Zidovudine

Accuracy

Accuracy was established across the specified range of the analytical procedure. Accuracy is the closeness of the test results obtained by the method to the true value. Recovery studies were carried out by addition of standard drug to the sample at 3 different concentration levels taking into consideration percentage purity of added bulk drug samples. The results of determination of accuracy are given in table 1.

Table 1. Results of Accuracy

% of Concentrations	Absorbance*	Average	SD	%RSD
30	0.257	0.25	0.00	1.01
60	0.366	0.36	0.00	0.69
120	0.519	0.52	0.01	1.02
* Average of 6 samples				

Precision

Standard solution of Zidovudine (60 µg/ml) were prepared and a spectrum was recorded. Absorbance was measured at 266 nm with water as the blank. The absorbance of the same concentration solution was measured six times and RSD was calculated. Repeatability data for Zidovudine was given in table 2.

Table 2. Precision data

S No	Absorbance	Assay
1	0.361	99.85
2	0.361	99.85
3	0.366	99.99
4	0.363	99.87
5	0.363	99.87
6	0.363	99.87
Average		99.88
SD		0.05
%RSD		0.05

Limit of detection (LOD) & limit of quantitation (LOQ)

The limit of detection and quantification of the zidovudine was calculated with the standard deviation and slop. And the LOD and LOQ was found to be 6.54µg/ml and 21.79µg/ml respectively.

4. Conclusion

The proposed method is simple, selective and sensitive. The obtained and statistical parameters for determination of zidovudine that the proposed UV spectrophotometry method by is simple, accurate, fast and precise. The method

showed acceptable linearity and accuracy. The proposed method is highly sensitive; therefore it could be used easily for the routine analysis of pure drugs in the quality control laboratories.

5. Acknowledgement

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