ISSN- 2230-7346
*Journal of Global Trends in Pharmaceutical Sciences*

# ESTIMATION OF BICTEGRAVIR IN BULK AND ITS FORMULATION BY SIMPLE UV - SPECTROSCOPIC METHOD

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**ARTICLE INFO**

**Key words:**
UV spectroscopy, λmax, Linearity, Standard deviation, Relative standard deviation.

Access this article online
Website:
https://www.jgtps.com/
Quick Response Code:

**ABSTRACT**

A rapid, accurate, and cost-effective UV-spectrophotometric method was developed and validated for the quantitative estimation of Bictegravir in bulk drug and pharmaceutical dosage forms. The analysis was performed using UV-visible spectrophotometry, and the maximum absorption (λmax) of Bictegravir was observed at 260 nm. The method demonstrated linearity over a concentration range of 2–12 µg/mL, with good correlation between absorbance and concentration, complying with Beer–Lambert's law.

The proposed analytical procedure was validated in accordance with standard validation parameters including linearity, precision, accuracy, and reproducibility. Statistical evaluation of the results confirmed that the method is reliable and within acceptable regulatory limits. Owing to its simplicity and minimal sample preparation requirements, the developed method can be effectively applied for routine quality control analysis of Bictegravir in bulk and tablet formulations.

## INTRODUCTION:

Bictegravir is a potent antiretroviral drug belonging to the class of integrase strand transfer inhibitors (INSTIs), widely used in the management of Human Immunodeficiency Virus type-1 (HIV-1) infection. It acts by selectively inhibiting the HIV-1 integrase enzyme, thereby preventing the integration of viral DNA into the host genome, which is a critical step in viral replication. Due to its strong antiviral efficacy, favorable safety profile, and once-daily dosing convenience, bictegravir has gained significant importance in combination antiretroviral therapy.

Bictegravir is administered in fixed-dose combination formulations with other antiretroviral agents such as tenofovir alafenamide and emtricitabine, improving patient adherence and therapeutic outcomes. The drug exhibits good oral absorption and demonstrates a suitable pharmacokinetic profile for once-daily administration. Chemically, bictegravir is a synthetic compound containing functional groups responsible for its UV absorption characteristics, making it amenable to spectrophotometric analysis.

Accurate and reliable analytical methods are essential for the quantitative estimation of bictegravir in bulk drug substances and pharmaceutical dosage forms to ensure quality, safety, and efficacy. Among the various analytical techniques



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available, UV-visible spectrophotometry remains one of the most widely used methods in pharmaceutical analysis due to its simplicity, cost-effectiveness, precision, and minimal requirement for sophisticated instrumentation. The present study focuses on the development and validation of a simple, rapid, and economical UV-spectrophotometric method for the estimation of bictegravir in bulk and its tablet formulation. The method aims to provide accurate quantification within a suitable concentration range in accordance with Beer-Lambert's law. Validation parameters such as linearity, accuracy, precision, and reproducibility are evaluated to establish the reliability of the proposed method for routine quality control analysis.

**DRUG PROFILE:**

Bictegravir is a potent antiretroviral agent belonging to the class of integrase strand transfer inhibitors (INSTIs). It is primarily used in the management of Human Immunodeficiency Virus Type-1 (HIV-1) infection. Bictegravir inhibits the HIV integrase enzyme, preventing the integration of viral DNA into the host genome, which is an essential step in viral replication.

Bictegravir is marketed as part of a fixed-dose combination product under the brand name Bictarvy, which also contains emtricitabine and tenofovir alafenamide.

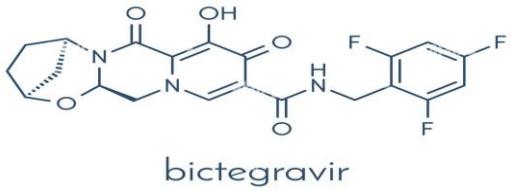


**Fig:1** Structure of Bictegravir

**Drug Name:** Bictegravir

**ChemicalName** : (1R,3S,11R)-5,11-dihydroxy-3-methyl-2,4-dioxo-N-[(2,4,6-trifluorobenzyl)]-1,4-dihydro-2H,6H-[1,3]oxazino[3,4-f][1,2,4]triazin-7-carboxamide

**Category:** Antiretroviral agent, HIV-1Integrase

**Molecular Formula:** $C_{21}H_{18}F_3N_3O_5$

**Molecular Weight:** 449.38 g/mol

**Class** : Integrase Strand Transfer Inhibitor (INSTI)

**Brand Name** : Bictarvy

**Solubility** : Water-low soluble organic solvents- soluble

**Melting Point** : 160-163°C

**Uses** : Bictegravir is used for the treatment of HIV-1infection in adults and children's.it is prescribed as a part of combination anti- retroviral therapy.

**METHODS AND MATERIALS**

**Materials:**

The Bictegravir was obtained as a gift sample from a reputed pharmaceutical source. The sample was used without further purification.

All reagents and solvents used in the study were of analytical grade. Distilled water was used throughout the analysis.

**Instruments:**

A double-beam UV–Visible spectro-photometer (Model 2080, Analytical Technologies Ltd., India) equipped with matched quartz cells of 1 cm path length was employed for all absorbance measurements. The instrument was connected to UV analysis software for spectral scanning and data processing.

An electronic analytical balance (Model 1N-201L) with appropriate sensitivity was used for accurate weighing of the drug sample and other reagents.

**METHOD DEVELOPMENT**

**Identification of Drug:** The drug was identified by determining melting point.

**Determination of melting point:**

The melting point of the bictegravir was found to be in the range of 160-163 °C with an average value of 162°C (average of 3 trails), indicating purity of the sample.

**Selection of solvent:**

The ability of a solid substance (solute) to dissolve in solvent and to form a solution. The sample is freely soluble in methanol, soluble in chloroform, slightly soluble in ethanol and poorly soluble in water. Based on solubility and economical parameters, methanol is selected as solvent.

**Determination of λmax:**

Accurately weighed 10mg of bictegravir was transferred into a 100ml volumetric flask. About 70ml of methanol was added and sonicated for complete dissolution. The volume was made up to the



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mark with methanol to obtain a standard stock solution of 100µg/ml, from this pipette out 1ml and make up the volume up to 10ml with water. Water is used as blank solution and screened between 200-400nm. The sample shows highest absorbance at 260nm.

**Preparation of Calibration Curve:**

The calibration curve was plotted over a concentration range of 2-12µg/ ml for Bictegravir by taking Bictegravir solution 0.2,0.4,0.6,0.8,1.0 and1.2 ml was shifted to a series of 10ml volumetric flask and make up the volume with water up to the mark. Calibration curve was prepared by taking readings at λmax 260nm and plotted a graph by taking the Bictegravir concentration on x-axis and their representative absorbance on y axis calibration data.

From the absorbance values a calibration curve was plotted in the desired concentration range. The curve obtained was linear with correlation coefficient 0.9988 which represented.

**Limit of Detection (LOD) And Limit of Quantification (LOQ) of Proposed Methods:**

The Limit of Detection (LOD) and Limit of Quantification (LOQ) of the developed analytical method were determined in accordance with the International Council for Harmonisation (ICH) Q2(R1) guidelines. The Limit of Detection (LOD) is defined as the lowest concentration of analyte in a sample that can be detected but not necessarily quantified under the stated experimental conditions. The Limit of Quantification (LOQ) is defined as the lowest concentration of analyte that can be quantitatively determined with acceptable precision and accuracy.

LOD and LOQ were calculated based on the standard deviation of the response (σ) and the slope (S) of the calibration curve obtained from linear regression analysis. The calibration curve was constructed using six different concentration levels within the specified range.

**Formulation Linearity:**

20 tablets of Bictegravir (Bictarvy - 10mg) were weighed accurately and powdered by using mortar and pestle. Powder equivalent to 10 mg of drug was transferred into a 100ml volumetric flask. About 70ml of methanol was added and sonicated for 15 minutes. Make up the volume up to 100 ml with methanol (100µg/ml), solution was mixed well and filtered through Whatman filter paper. From the filtrate pipette out 0.2, 0.4, 0.6, 0.8. 1.0 and 1.2ml were transferred into a series of 10ml volumetric flask and the volume was made up to mark with water to obtain concentrations of 2,4,6,8,10 and 12µg/ml were prepared. The absorbance was measured at 260nm.

**Accuracy:**

To check the accuracy of the developed method and to study interference of formulation excipients, recovery studies were conducted by taking 6µg/ml solution of formulation in each of three 10 ml volumetric flask and then add 0.2,0.4 & 0.6 ml of working standard bictegravir and make up the mark with water. The solution was prepared in triplicate. The readings were taken and the amount recovered is calculated by using formula Y= mx+c.and the percentage recovery was calculated and given in the table-2.

**Recovery:**

To 0.6ml of sample solution add 0. 2, 0.4, 0.6ml of working standard solution (100 µg/ml) in a 10ml volumetric flask and make up the volume with water and readings were taken at 260nm. By taking absorbance values the amount recovered was calculated by using Y=mx+c formula and percentage recovery was given in table-2.

**Precision:**

To check the precision of the proposed method the recovery studies performed between 3 days each day one time (intra-day) and on the same day recovery studies performed per day one (inter-day) were analyzed. The relative standard deviation of intra-day and inter-day values were calculated. The precision is expressed in the form of percent relative standard deviation. Respectively pertaining to bictegravir and the value of RSD% (<2.0) clearly shows that the method is fairly precise.



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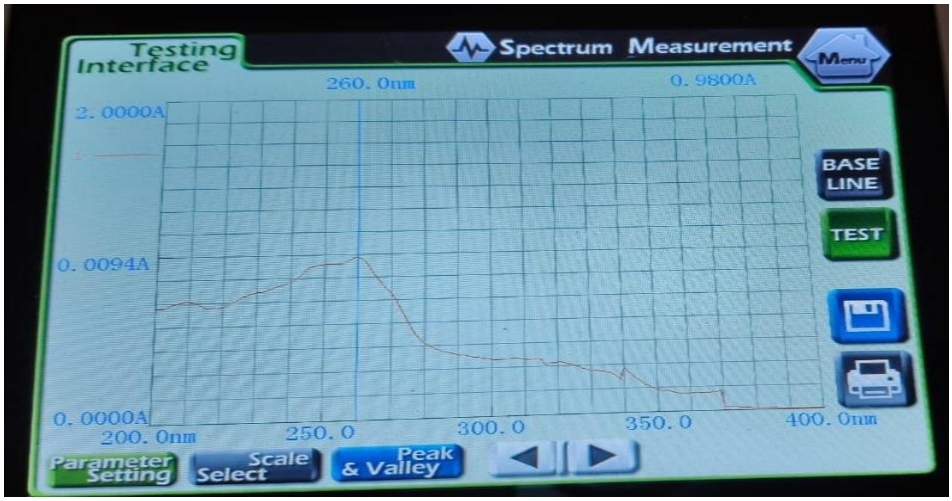


**Fig:2** Determination of λmax

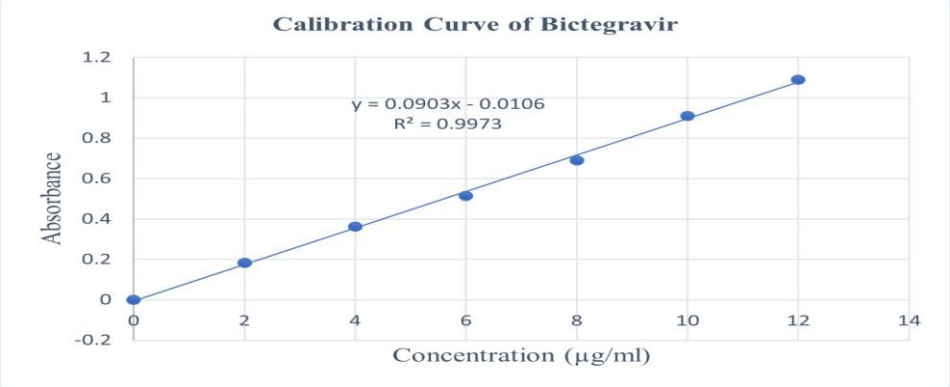


**Fig:3** Calibration Curve of Bictegravir

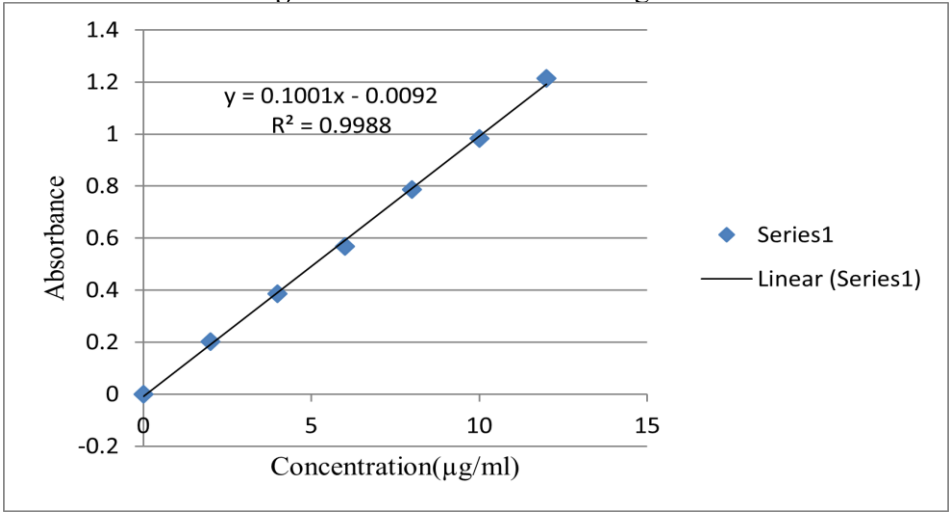


**Fig:4** Formulation Linearity curve

| S. No | Slope | LOD(µg/ml) | LOQ(µg/ml) | SD |
|---|---|---|---|---|
| 1 | 0.0908 | 0.1469 | 0.4449 | 0.00428 |
| 2 | 0.0982 | | | |
| 3 | 0.0993 | | | |
| 4 | 0.0904 | | | |
| 5 | 0.1008 | | | |
| 6 | 0.0976 | | | |

**Table:1** LOD and LOQ



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| Trails | Amt of drug present in (µg/ml) | Amount added (µg/ml) | Absorbance | Amount Recovery (µg/ml) | Percentage (%) | SD | RSD |
|---|---|---|---|---|---|---|---|
| 1 | 6 | 2 | 0.6904 | 2.01 | 100.5 | 0.2677 | 0.2672 |
| 2 | 6 | 2 | 0.6914 | 2.02 | 100.1 | | |
| 3 | 6 | 2 | 0.6920 | 2.02 | 101.4 | | |
| 4 | 6 | 4 | 0.8670 | 3.96 | 99.1 | | |
| 5 | 6 | 4 | 0.8681 | 3.97 | 99.4 | | |
| 6 | 6 | 4 | 0.8691 | 3.99 | 99.7 | | |
| 7 | 6 | 6 | 1.0500 | 5.99 | 99.88 | | |
| 8 | 6 | 6 | 1.0531 | 6.02 | 100.4 | | |
| 9 | 6 | 6 | 1.0515 | 6.00 | 100.1 | | |

**Table:2** - Recovery of Bictegravir

| S. No | Parameter | Result |
|---|---|---|
| 1 | Detection of wavelength | 260nm |
| 2 | Beer-Lamberts law (µg/ml) | 2-12µg/ml |
| 3 | Regression equation (y=mx+c ) | 0.9976 |
| 4 | Slope | 0.09618 |
| 5 | Accuracy (% mean recovery) | 100.03% |
| 6 | LOD | 0.1469µg/ml |
| 7 | LOQ | 0.4449 µg/ml |
| 8 | Standard deviation | 0.00428 |
| 9 | Relative standard deviation | 0.2672 |

**Table: 3** Results

## SUMMARY

A UV-Spectrophotometric method has been developed and validated for determination of Bictegravir in bulk and its formulation. The process was done by using methanol and water as solvent with the detection wavelength of 260 nm. Bictegravir was checked for its stability in the choosen solvent and found to be stable. The method was linear with correlation coefficient 0.9988 in the concentration range of 2-12 µg/ml. The limit of detection and limit of quantification were 0.1469 µg/ml and 0.4449 µg/ml, respectively. The intra and inter-day precisions were satisfactory; the relative standard deviations did not exceed 2%. The accuracy of the method is high as can be seen from the mean recovery values of Bictegravir which were in the range of 2-12 µg/ml. The method met the ICH regulatory requirements and the results of validation are summarized in table-3.

## CONCLUSION

A simple, novel, economical, rapid, precise and accurate UV Spectro photometric method was developed for estimation of Bictegravir in bulk and its formulations. The method was developed by using methanol and water as solvent. The developed method was validated from parameters via accuracy, precesion and linearity, limit of detection and limit of quantification as per ICH guidelines. All the parameters were found to be with in the acceptance limits. The results indicated that the proposed method for the estimation of Bictegravir is very accurate and cost effective and can be employed in routine sample analysis of Bictegravir in bulk and its formulation.

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