World Journal of Pharmaceutical Sciences
ISSN (Print): 2321-3310; ISSN (Online): 2321-3086
Available online at: https://wjpsonline.com/
Research Article

DEVELOPMENT AND VALIDATION OF AN RP-HPLC METHOD FOR THE SIMULTANEOUS ESTIMATION OF NIRAPARIB AND ABIRATERONE ACETATE IN PHARMACEUTICAL DOSAGE FORMS

Kudala Shashidhar*, C Rupasi Pratyusha, S. Shahidha Bee, Dr. MD Sultan Ali Basha

Department of Pharmaceutical Analysis, SAFA College of Pharmacy, B.Thandrapadu, Kurnool, Andhra Pradesh- 518007, Email: kudalashashi@gmail.com.

Received: 31-05-2025 / Revised Accepted: 02-06-2025 / Published: 05-06-2025

ABSTRACT:
A simple, accurate, and precise reverse-phase high-performance liquid chromatographic (RP-HPLC) method was developed and validated for the simultaneous estimation of Niraparib and Abiraterone Acetate in tablet dosage forms. The separation was achieved on a BDS C18 column (250 mm × 4.6 mm, 5 µm particle size) using a mobile phase consisting of sodium dihydrogen phosphate buffer and acetonitrile in the ratio of 40:60 v/v, delivered at a flow rate of 1.0 mL/min. The detection wavelength was set at 234 nm, and the retention times for Niraparib and Abiraterone Acetate were found to be 2.8 minutes and 7.6 minutes, respectively. The method was validated according to ICH guidelines and demonstrated excellent linearity, precision, accuracy, robustness, and system suitability. This method proved to be efficient and reliable for routine analysis of the combination product in quality control laboratories.

INTRODUCTION

Quantitative analytical methods are essential in the pharmaceutical industry to ensure drug quality, safety, and efficacy. High-performance liquid chromatography (HPLC) has become the method of choice due to its superior sensitivity, accuracy, and reproducibility. In the case of combination drug therapies, such as Niraparib and Abiraterone Acetate, it is necessary to establish analytical procedures that can estimate both active components simultaneously. These combinations are increasingly used in oncology, especially in managing prostate and ovarian cancers. However, official methods for such combinations are often unavailable, necessitating the development of new, validated analytical techniques that are not only efficient but also economical and reproducible.

Niraparib is a selective poly (ADP-ribose) polymerase (PARP) inhibitor used primarily for maintenance therapy in epithelial ovarian and fallopian tube cancers. It exhibits excellent oral bioavailability and has a long elimination half-life, making it suitable for once-daily dosing. Abiraterone Acetate, on the other hand, is a steroidal CYP17A1 inhibitor that reduces androgen production and is primarily used in the treatment of metastatic prostate cancers. Given their co-administration in clinical practice, the development of a validated RP-HPLC method for their simultaneous quantification is of high pharmaceutical relevance.

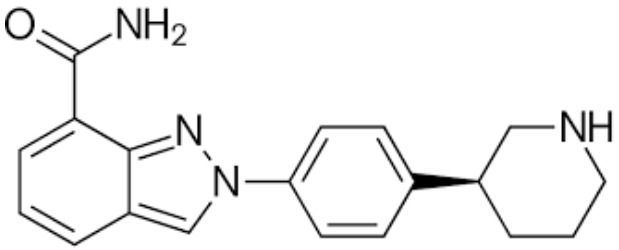

Fig: 1. Chemical Structure of Niraparib

Address for Correspondence: Kudala Shashidhar, Department of Pharmacology, SAFA College of Pharmacy, B.Thandrapadu, Kurnool, Andhra Pradesh- 518007, Mail: kudalashashi@gmail.com.

How to Cite this Article: Kudala Shashidhar, DEVELOPMENT AND VALIDATION OF AN RP-HPLC METHOD FOR THE SIMULTANEOUS ESTIMATION OF NIRAPARIB AND ABIRATERONE ACETATE IN PHARMACEUTICAL DOSAGE FORMS, World J Pharm Sci 2025; 13(02): 148-152; https://doi.org/10.54037/WJPS.2022.100905

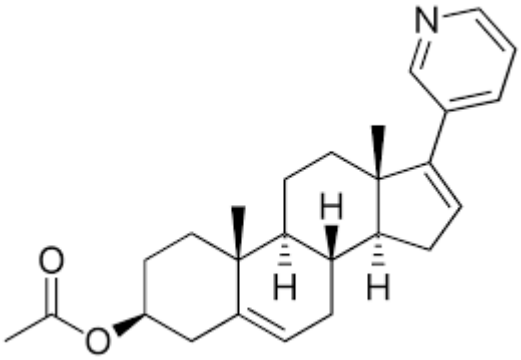

Fig 2. Chemical Structure of Abiraterone Acetate

The primary objective of this study was to develop and validate a simple, cost-effective, accurate, and precise RP-HPLC method for the simultaneous estimation of Niraparib and Abiraterone Acetate in tablet dosage forms. The study also aimed to apply the validated method to real pharmaceutical formulations in compliance with ICH Q2(R1) guidelines.

Materials and Methods

The analytical work was conducted using pharmaceutical-grade Niraparib and Abiraterone Acetate, as well as a marketed combination product, Akeega Tablets, containing 50 mg of Niraparib and 500 mg of Abiraterone Acetate. The chromatographic system consisted of a Waters 2965 HPLC instrument equipped with a PDA detector and operated using Empower 2 software.

Preparation of Standard Solution:

Accurately Weighed and transferred 1mg & 10mg of Niraparib and Abiraterone Acetate working Standards into a 10 ml clean dry volumetric flask separately, add 7ml of diluent, sonicated for 30 minutes and make up to the final volume with diluents. From the above solution, 1 ml was pipetted out in to a 10ml Volumetric flask and then make up to the final volume with diluent.

Preparation of Sample Solution:

5 tablets were weighed and calculate the average weight of each tablet then the weight equivalent to 5 tablets was transferred into a 25ml volumetric flask, 20ml of diluent added and sonicated for 30 min, further the volume made up with diluent and filtered. From the filtered solution 0.5ml was pipeted out into a 10 ml volumetric flask and made upto 10ml with diluent.

Results and Discussion

Method development: Chromatographic separation was performed using a BDS C18 column (250 mm × 4.6 mm, 5 µm). The mobile phase was prepared by mixing sodium dihydrogen phosphate buffer (pH adjusted to 4.0 with orthophosphoric acid) and acetonitrile in a ratio of 40:60 v/v. The mobile phase was filtered and degassed prior to use. The flow rate was maintained at 1.0 mL/min, the injection volume was 10 µL, and the detection wavelength was set at 234 nm. The analysis was carried out at a column temperature of 30°C.

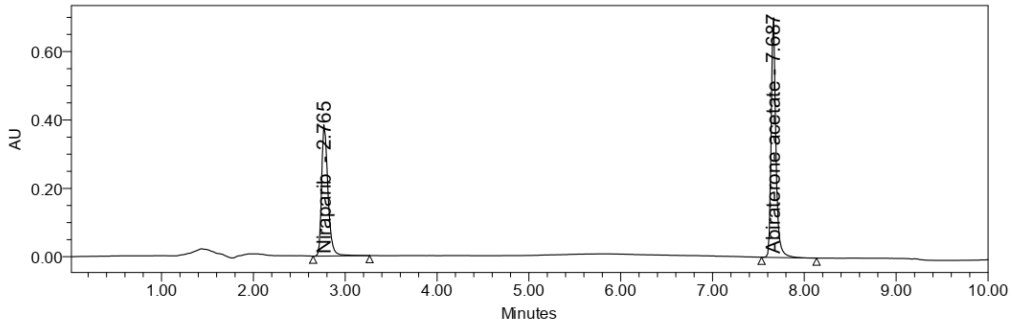

Fig 3. Optimized Chromatogram of Niraparib and Abiraterone Acetate

Method Validation

The developed method was validated according to ICH Q2(R1) guidelines for system suitability, linearity, precision, accuracy, robustness, and sensitivity parameters such as LOD and LOQ.

System suitability:

System suitability testing showed that both drugs produced well-resolved peaks with retention times of 2.8 minutes for Niraparib and 7.6 minutes for Abiraterone Acetate. The tailing factors were below 1.5 and the theoretical plate counts were greater than 4950, indicating good column performance and peak symmetry.

Linearity:

Linearity was evaluated over the concentration range of 2.5–15 µg/mL for Niraparib and 25–150 µg/mL for Abiraterone Acetate. The calibration curves were linear with correlation coefficients (r^2) of 0.999 for both drugs. The regression equation for Niraparib was y = 87123x − 577, while for Abiraterone Acetate it was y = 25297x − 7072.

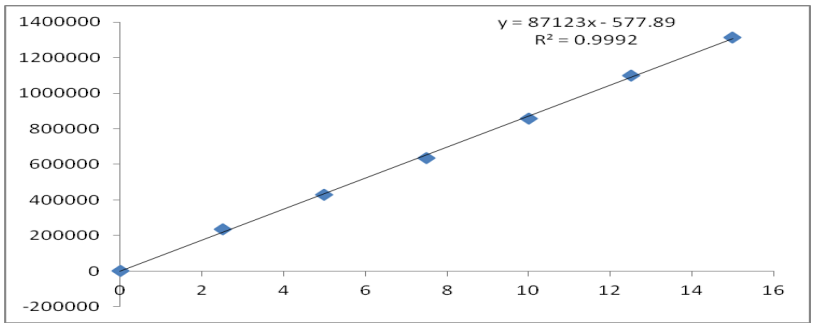

Fig : 4. Calibration curve of Niraparib

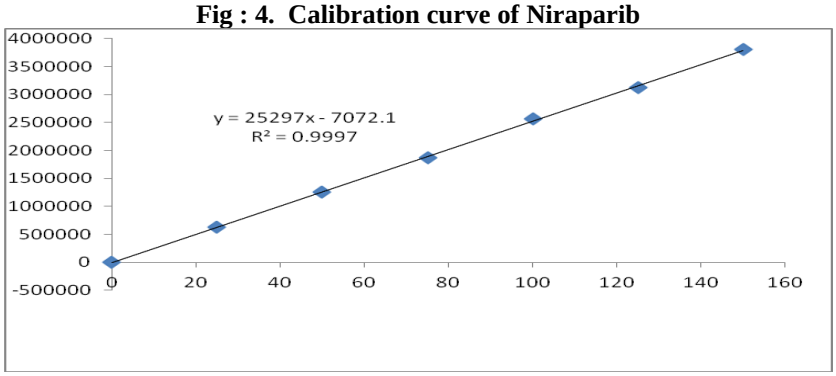

Fig : 5. Calibration curve of Abiraterone Acetate.

Precision:

Precision was demonstrated through intra-day (repeatability) and inter-day studies. The %RSD for repeatability was 0.5% for Niraparib and 1.2% for Abiraterone Acetate. Intermediate precision evaluated over different days showed %RSD values of 0.4% and 0.6% for Niraparib and Abiraterone Acetate, respectively, confirming the method's reproducibility.

Table: 1. Repeatability results for Niraparib and Abiraterone Acetate

Sr. No.	Niraparib	Abiraterone Acetate
1	859452	2566137
2	859641	2600887
3	847596	2510889
4	854781	2582035
5	856412	2579749
6	857986	2545563
Mean	**855978**	**2564210**
Std.Dev	**4503.3**	**31934.1**
%RSD	**0.5**	**1.2**

Table: 2. Inter day precision results for Niraparib and Abiraterone Acetate

Sr. No.	Niraparib	Abiraterone Acetate
1	854713	2570173
2	854716	2543986
3	854112	2542655
4	856941	2559186
5	847519	2573392
6	856923	2576695
Mean	**854154**	**2561015**
Std.Dev.	**3466.6**	**14922.1**
%RSD	**0.4**	**0.6**

Accuracy:

Accuracy was assessed by recovery studies conducted at three levels: 50%, 100%, and 150% of the target concentration. The average recovery values ranged from 98.27% to 99.20% for Niraparib and from 98.40% to 99.78% for Abiraterone Acetate, indicating excellent accuracy.

Table: 3. Accuracy results of Niraparib and Abiraterone Acetate

Sample	Amount added (µg/ml)	Amount recovered (µg/ml)	Recovery (%)
Niraparib	5	4.96	99.20
	10	9.86	98.60
	15	14.74	98.27
Abiraterone Acetate	50	49.54	99.08
	100	99.78	99.78
	150	147.6	98.40

LOD and LOQ:

The limits of detection were calculated to be 0.23 µg/mL for Niraparib and 0.67 µg/mL for Abiraterone Acetate, while the limits of quantification were 0.70 µg/mL and 2.12 µg/mL respectively. These low values indicate that the method is sufficiently sensitive for trace analysis.

Robustness:

Robustness of the method was tested by making small deliberate variations in method parameters such as flow rate, mobile phase composition, and temperature. The results were consistent with acceptable %RSD values below 0.5%, demonstrating the method's robustness.

Assay of Marketed Formulation:

The validated method was applied to determine the content of Niraparib and Abiraterone Acetate in the Akeega Tablet formulation. The average percentage assay was found to be 99.78% for Niraparib and 99.97% for Abiraterone Acetate, confirming the suitability of the method for routine pharmaceutical analysis.

CONCLUSION

The RP-HPLC method developed for the simultaneous estimation of Niraparib and Abiraterone Acetate is accurate, precise, sensitive, and robust. It meets all the validation criteria as per ICH guidelines and can effectively separate both analytes with good resolution and short run time. This method is suitable for regular quality control analysis in pharmaceutical industries, offering a cost-effective and reliable solution for the determination of Niraparib and Abiraterone Acetate in combined dosage forms.

REFERENCES

1. ICH Harmonised Tripartite Guideline. Validation of Analytical Procedures: Text and Methodology Q2(R1). Geneva: International Conference on Harmonisation; 2005.
2. Snyder LR, Kirkland JJ, Dolan JW. Introduction to Modern Liquid Chromatography. 3rd ed. Hoboken (NJ): Wiley; 2010.
3. Dong MW. Modern HPLC for Practicing Scientists. Hoboken (NJ): Wiley; 2006.
4. Ahuja S, Scypinski S. Handbook of Modern Pharmaceutical Analysis. 2nd ed. London: Academic Press; 2010.
5. Ermer J, Miller JH. Method Validation in Pharmaceutical Analysis: A Guide to Best Practice. Weinheim: Wiley-VCH; 2005.
6. Satana Kara HE, Altuntas TG. Stability-indicating RP-HPLC method for determination of Abiraterone acetate in bulk and dosage forms. J Pharm Biomed Anal. 2020;182:113128.
7. Cander H, Altunay N. Green HPLC method for estimation of Abiraterone acetate in pharmaceutical formulations. J Sep Sci. 2021;44(3):567–575.
8. Wani TA, Zargar S, Ahmad A. UPLC-MS/MS method for determination of Abiraterone in human plasma. J Chromatogr B. 2020;1139:121963.
9. Gurav S, Jadhav S, Bhosale A. Development of RP-HPLC method for estimation of Abiraterone in rat plasma. Biomed Chromatogr. 2019;33(4):e4452.
10. Patel K, Trivedi P. Development and validation of RP-HPLC method for Niraparib in pharmaceutical formulations. Int J Pharm Sci Res. 2020;11(5):2252–2258.

11. Sharma R, Mahajan MP. A validated stability-indicating HPLC method for Niraparib in bulk drug. Indian J Pharm Sci. 2019;81(6):1050–1056.
12. Yu A, Wang X, Lin J. Development of LC-MS/MS method for Niraparib quantification in human plasma. J Pharm Biomed Anal. 2020;180:113039.
13. Jain S, Verma A. RP-HPLC method development for stability studies of Niraparib in presence of impurities. J Appl Pharm Sci. 2021;11(8):106–112.
14. Gupta N, Bansal M. Spectrophotometric estimation of Niraparib in pharmaceutical formulations. Int J Pharm Pharm Sci. 2020;12(3):64–68.
15. Satana Kara HE, Kalayci D. Simultaneous estimation of Niraparib and Abiraterone using UPLC: A stability-indicating study. J Pharm Biomed Anal. 2021;197:113964.