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EVALUATION AND VALIDATION OF A UPLC METHOD FOR THE STABILITY INDICATING ASSAY OF MIDOSTAURIN IN IN CAPSULE DOSAGE FORM USING UPLC-MS/MS^n

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ABSTRACT

This proposal provides a comprehensive review of the optimization and approval of the LCMS technology for evaluating midostaurin, a chemical that potentially be a tyrosine kinase inhibitor. Analysts had to choose a permanent and movable stage, as well as develop standard stock and diluent arrangements, in order to find the best circumstances for division. The study indicated that a BDS C18 provided the best determination and affectability when combined with slope programming, using a portable stage of methanol and acetonitrile (80:20 v/v). By analyzing the method's precision, linearity, adaptability, and exactness, the panel also looked at the method's validity. Considerations of accuracy showed respectable recoveries, with a brutality level of 99.28%. There were factually irrelevant ponders of correctness that proved the system and approach were accurate.

KEYWORDS: Midostaurin, generation of degradation products and evaluation of the analytical method.

INTRODUCTION

Ensuring the quality, safety, and effectiveness of pharmaceutical products relies heavily on the development and validation of analytical techniques in the field of pharmaceutical analysis. Rigid and exact procedures are required for the quantitative analysis of APIs in bulk dosage forms in order to fulfill regulatory criteria. A technique for the bulk dosage form estimation of midostaurin using Ultra-Performance Liquid Chromatography (UPLC) is the subject of this study's assessment and validation.

The tyrosine kinase inhibitor midostaurin has recently been the subject of much interest due to its possible therapeutic use, mainly in the management of certain types of blood cancers. For the sake of both therapeutic efficacy and regulatory compliance, it is essential to accurately determine the midostaurin content in bulk medicinal preparations.

The benefits of ultra-performance liquid chromatography (UPLC), such as high resolution, fast analysis, and enhanced sensitivity, have led to its growing popularity in pharmaceutical analysis. To guarantee accuracy, dependability, and repeatability of findings, a thorough validation procedure is required for the effective deployment of UPLC techniques.

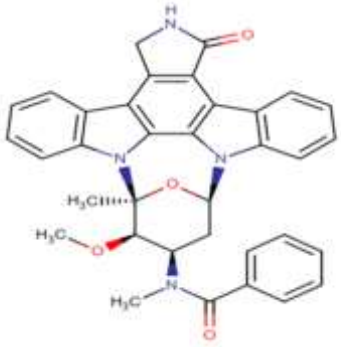
In order to estimate midostaurin in bulk dosage forms, this project will first develop a reliable UPLC technique and then evaluate its analytical performance. To determine whether the technique is suitable for regular pharmaceutical analysis, the validation procedure takes into account a number of factors, including specificity, precision, accuracy, linearity, robustness, and system appropriateness. Findings from this study have implications for both midostaurin analytical technique and pharmaceutical analysis more generally, highlighting the need for proven procedures to guarantee the security and efficacy of pharmaceuticals.

Drug Profile

Therapeutic category	**Antineoplastic Agent**
CAS Registry number	120685-11-2
Chemical name	4'-N-benzoylstaurosporine
Molecular formula	$C_{35}H_{30}N_4O_4$
Molecular Weight	570.649
Solubility	≥ 2.5 mg/mL
pka	13.45
λ_{max}	292 nm

MIDOSTAURIN

Chemical Structure of Midostaurin



Experimental

Methodology

Method Validation

What we mean when we talk about "the analytical technique" is the method by which the analysis is carried out. All of the analytical procedures should be spelled out in great detail. The sample, the reference standard, and the reagents, as well as their preparations, the use of the equipment, the development of the calibration curve, the application of the formulas for the calculation, etc. There has been comprehensive validation of the disclosed technique for its specificity, system appropriateness, linearity, accuracy, precision, limit of detection, limit of quantification, and robustness.

RESULTS

Validation of Forced Degradation for Midostaurin

Evaluation of Methods

Assay Studies

Recovery level	Set No.	Midostaurin	
		Wt. Taken (µg/ml)	Amount found (µg/ml)
50%	**Set 1**	02.04	02.02
	Set 2	02.06	02.03
	Set 3	02.08	02.07
100%	**Set 1**	04.12	04.11
	Set 2	04.14	04.13
	Set 3	04.16	04.15
150%	**Set 1**	06.14	06.13
	Set 2	06.16	06.15
	Set 3	06.18	06.17

Accuracy study for Analytical Method Validation (Midostaurin)

System Precision

Procedure

The parameters, retention time (RT), theoretical plates (N), tailing factor (T), peak asymmetry (As) and repeatability were evaluated at a concentration of 4µg/mL (Midostaurin).

Parameters	Midostaurin
Retention time (min) ± % RSD	8.775 ± 0.04
Theoretical plates ± % RSD	2377.56 ± 0.50
Asymmetry ± % RSD	1.08 ± 0.05
Repeatability (% RSD)	0.11

System Precision (Midostaurin)

Robustness

Procedure

1. **Change in flow rate**
2. **Change in temperature**
3. **Change in wave length**

The robustness was studied by evaluating the effect of small but deliberate variations in the chromatographic conditions. The conditions studied were flow rate (± 0.05), column temperature (± 2°C) and wavelength of detection (± 5 nm). The result of robustness study of the developed assay method was established. The result shown that during all variance conditions, assay value of the test preparation solution was not affected and it was in accordance with that of actual. System suitability parameters were also found satisfactory; hence the analytical method would be concluded as robust.

Robustness Studies			
Parameter	**Value**	**Peak Area**	**% RSD**
Flow Rate	**Low**	27548	0.13%
	Actual	27592	
	Plus	27619	
Temperature	**Low**	27563	0.16%
	Actual	27646	
	Plus	27629	
Wavelength	**Low**	27548	0.14%
	Actual	27593	
	Plus	27626	

Robustness Studies (Midostaurin)

Ruggedness

Intraday precision (Repeatability): Intraday Precision was performed and % RSD for Midostaurin was 0.11%."

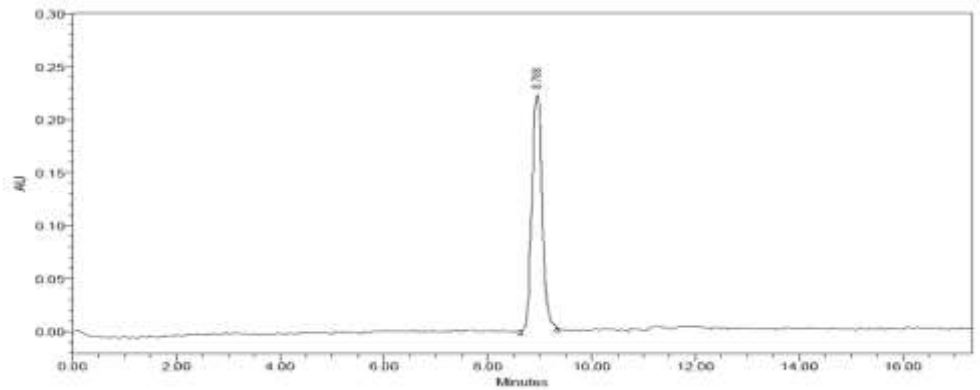
Inter day precision: Inter day precision was performed with 24 hrs time lag and the %RSD Obtained for Midostaurin was 0.15%.

Midostaurin			
Ruggedness			
Parameter	**Peak Area**	**% RSD**	**%LC**
Intraday precision	**27158**	**0.11%**	**99.77%**
	27212		**99.97%**
	27164		**99.79%**
Inter day precision	**27145**	**0.15%**	**98.72%**
	27229		**99.96%**
	27182		**99.86%**
Instrument:1 Acquity UPLC Waters,2695H	**27118**	**0.04%**	**99.62%**
	27139		**99.70%**
	27121		**99.63%**
Instrument:2 Agilent Technologies,1290	**27117**	**0.04%**	**99.62%**
	27134		**99.68%**
	27117		**99.62%**
Average			**99.66**
Std.Dev			**0.322**
%RSD			**0.32%**

Ruggedness Parameters (Midostaurin)

Forced Degradation Studies

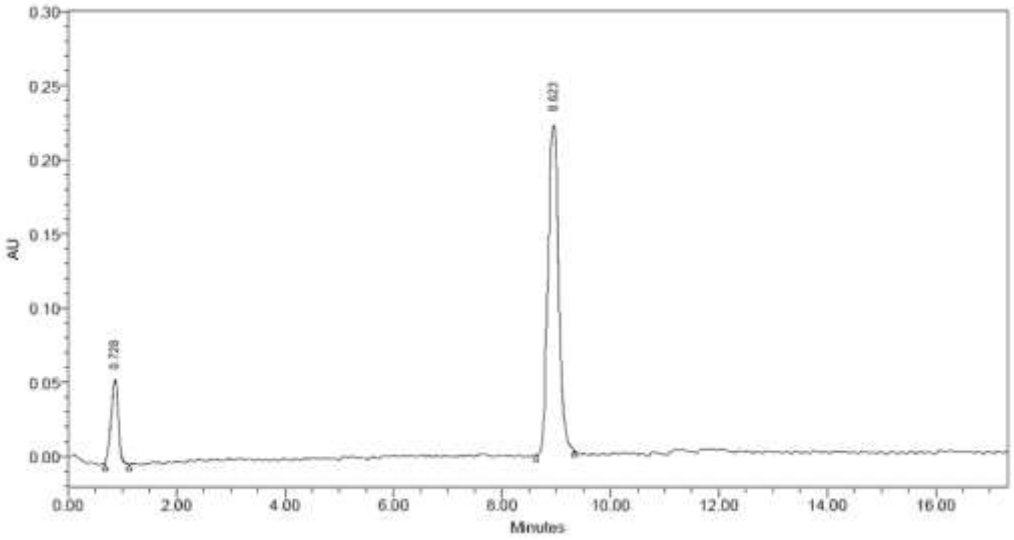
Sample Control: An accurate 10 ml of the prepared pure drug stock solution of working standard was transferred to a clean and dry RBF. The volume of the sample was 100µg/ml. It was injected into the UPLC system against a blank of Methanol and Acetonitrile in the ratio of 80:20 %v/v after optimizing the mobile phase composition, chromatogram was recorded.



Assay of Midostaurin (Sample Control)

a. Acidic Degradation

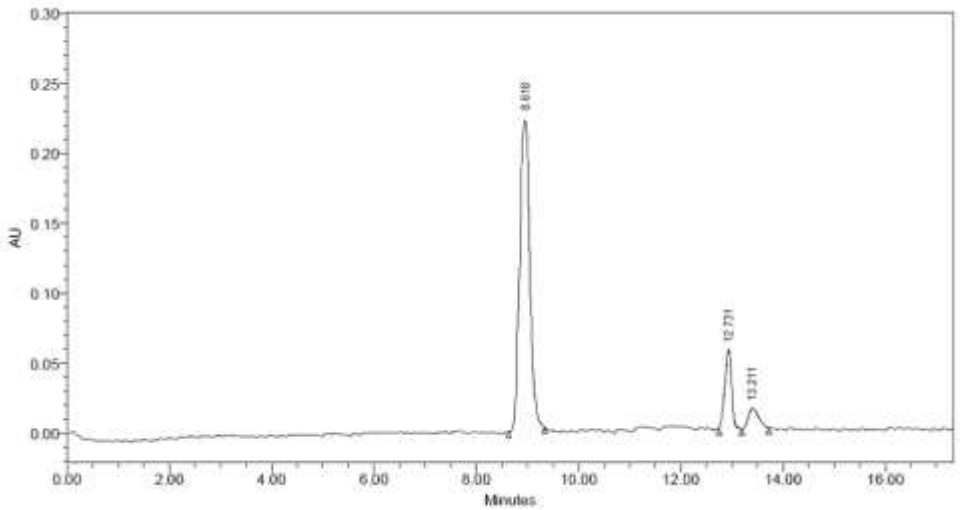
An accurate 10 ml of pure drug sample solution was transferred to a clean and dry round bottom flask (RBF). 30 ml of 0.1 N HCl was added to it. It was refluxed in a water bath at 60°C for 4 hours. Drug became soluble after reflux which was insoluble initially. Allowed to cool at room temperature. The sample was then neutralized using 2N NaOH solution and final volume of the sample was made up to 100ml with water to prepare 100ppm solution. It was injected into the UPLC system against a blank of Methanol and Acetonitrile in the ratio of 80:20 %v/v after optimizing the mobile phase composition, chromatogram was recorded and shown in Chromatogram."



Chromatogram showing the degraded products in Acidic degradation

b. Basic Degradation

An accurate 10 ml of pure drug sample solution was transferred to a clean and dry RBF. 30 ml of 0.1N NaOH was added to it. It was refluxed in a water bath at 60°C for 4 hours. Drug became soluble after reflux which was insoluble initially. It was allowed to cool at room temperature. The sample was then neutralized using 2N HCl solution and final volume of the sample was made up to 100ml with water to prepare 100ppm solution. It was injected into the UPLC system against a blank of Methanol and Acetonitrile in the ratio of 80:20 %v/v after optimizing the mobile phase composition, chromatogram was recorded and shown in Chromatogram."

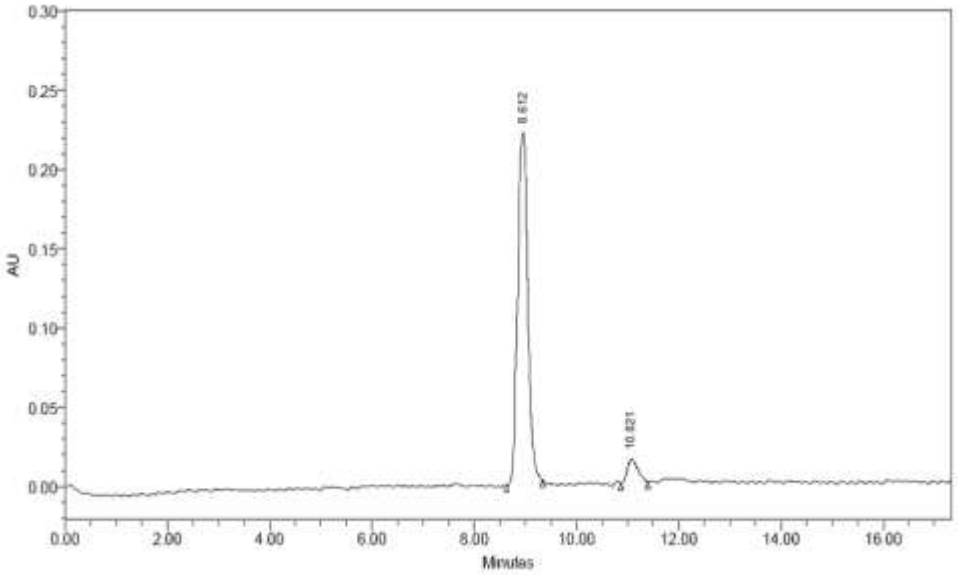


Chromatogram showing the degraded products in Basic degradation

c. Wet heat degradation

Accurate 10 ml of pure drug sample was transferred to a clean and dry RBF. 30 ml of HPLC grade water was added to it. Then, it was refluxed in a water bath at 60°C for 6 hours uninterruptedly. After the completion of reflux, the drug became soluble and the mixture of drug and water was allowed to cool at room temperature. Final volume was made up to 100 ml with HPLC grade water to prepare 100 ppm solution. It was injected into the UPLC system against a blank of Methanol and

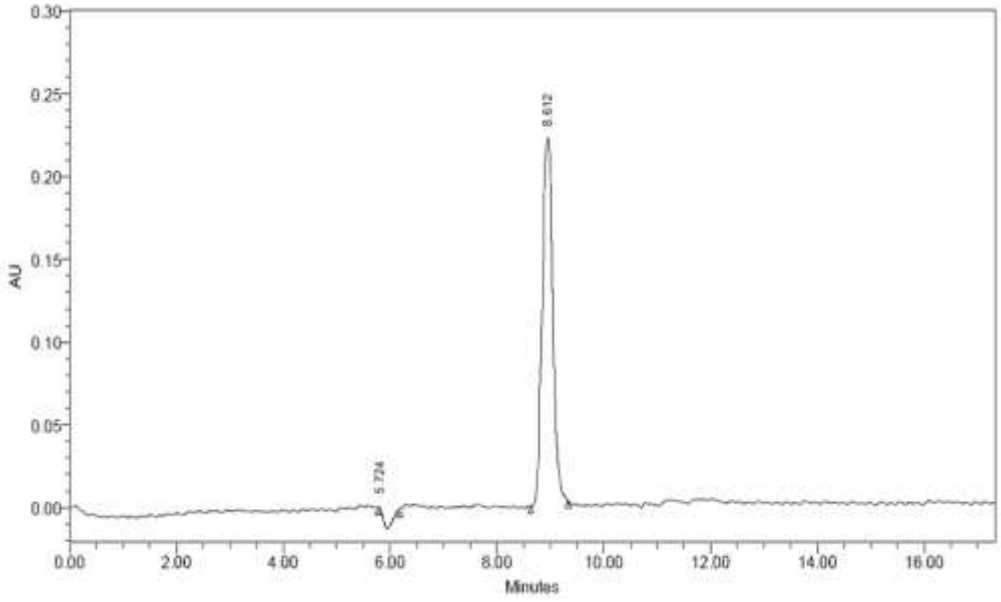
Acetonitrile in the ratio of 80:20 %v/v after optimizing the mobile phase composition, chromatogram was recorded and shown in Chromatogram.



Chromatogram showing the degraded products in Wet heat degradation

d. Oxidation with (3%) H_2O_2

Approximately 10 ml of pure drug sample was transferred in a clean and dry 100 ml volumetric flask. 30 ml of 3% H_2O_2 and a little methanol was added to it to make it soluble and then kept as such in dark for 24 hours. Final volume was made up to 100 ml using water to prepare 100 ppm solution. The above sample was injected into the UPLC system. The chromatogram was recorded and shown in Chromatogram."



Chromatogram showing the degraded products in Oxidative degradation

Nature of Stress	Degradation condition	Time(h)	Number of degradation products (Rt)
Acidic	60°C	3	1 (0.728)
Basic	60°C	9	2 (12.731, 13.211)
Oxidative	RT	48	1 (5.724)
Wet Heat	105°C	24	1 (10.821)

Summary of Forced Degradation Studies (Midostaurin)

Forced Degradation Studies
Analysis of Midostaurin

Conditions	Sample Amount (µg/ml)	Peak Area	% claim	% Degradation
Sample Control	04.15	26139	91.69%	-
Acidic Degradation	04.08	24721	*86.73%*	4.96%
Basic Degradation	04.05	23581	*82.72%*	8.97%
Oxidative Degradation	04.03	24357	*85.44%*	6.25%
Wet Heat	04.06	25832	*90.62%*	1.07%

Results of Forced Degradation Assays (Midostaurin)
Calculation formula for Midostaurin

$$\%\ Assay = \frac{AT}{AS} \times \frac{W1}{100} \times \frac{1}{25} \times \frac{100}{W2} \times \frac{25}{1} \times \frac{AW}{LC} \times P$$

Whereas,"
AT = Average area of test preparation, 26139"
AS = Average area of standard preparation, 28358"
W1 = Weight taken of reference standard (µg), 04.15"
W2 = Weight taken of test sample (µg), 04.25"
AW = Average weight of sample (µg), 3057"
LC = Label claim (µg), 3000"
P = Potency of reference standard (%), 99.98%"

$$\%\ Assay = \frac{AT}{AS} \times \frac{W1}{100} \times \frac{1}{25} \times \frac{100}{W2} \times \frac{25}{1} \times \frac{AW}{LC} \times P$$

Sample Control (Midostaurin)

$$\%\ Assay = \frac{26139}{28358} \times \frac{04.15}{100} \times \frac{1}{25} \times \frac{100}{04.25} \times \frac{25}{1} \times \textbf{Error!} \times 99.98$$

= 91.69%

Acidic Degradation (Midostaurin)

$$\%\ Assay = \frac{24721}{28358} \times \frac{04.15}{100} \times \frac{1}{25} \times \frac{100}{04.25} \times \frac{25}{1} \times \textbf{Error!} \times 99.98$$

= *86.73%*

Basic Degradation (Midostaurin)

$$\%\ Assay = \frac{23581}{28358} \times \frac{04.15}{100} \times \frac{1}{25} \times \frac{100}{04.25} \times \frac{25}{1} \times \textbf{Error!} \times 99.98$$

= *82.72%*

Oxidative Degradation (Midostaurin)

$$\%\ Assay = \frac{24357}{28358} \times \frac{04.15}{100} \times \frac{1}{25} \times \frac{100}{04.25} \times \frac{25}{1} \times \textbf{Error!} \times 99.98$$

= *85.44%*

Wet Heat (Midostaurin)

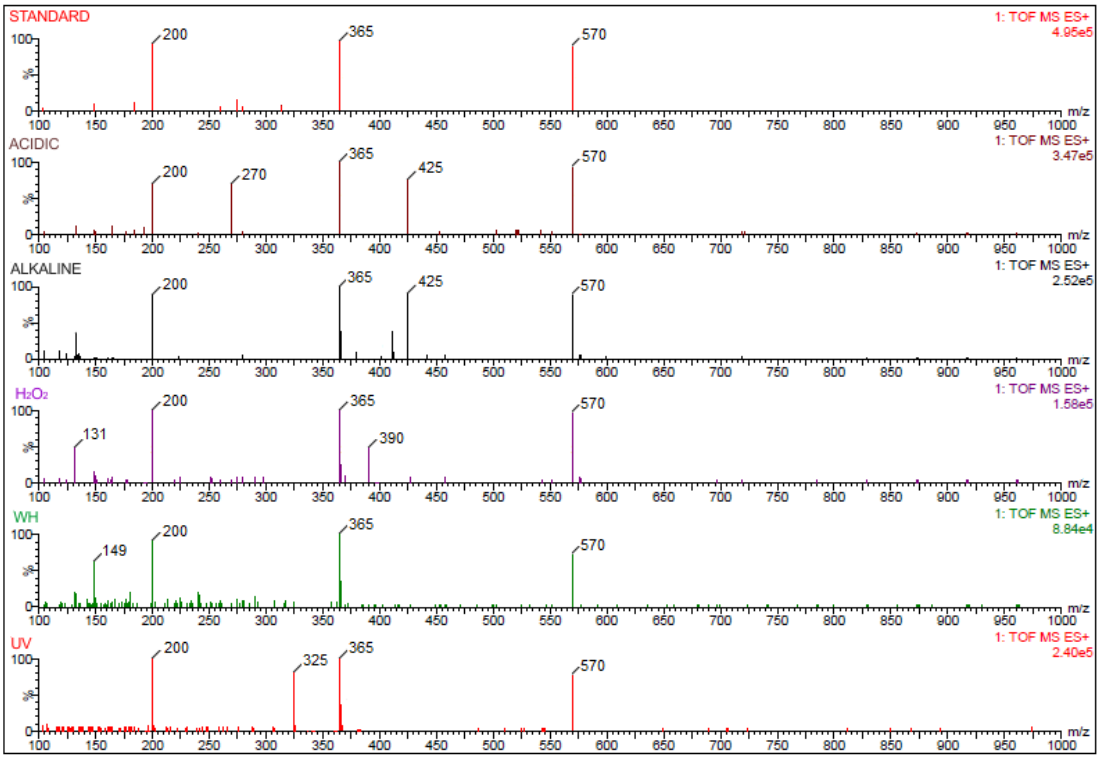
$$\%\ Assay = \frac{25832}{28358} \times \frac{04.15}{100} \times \frac{1}{25} \times \frac{100}{04.25} \times \frac{25}{1} \times \textbf{Error!} \times 99.98$$

= *90.62%*

Elemental compositions of Midostaurin in MS/MS spectra

Analyte	Observed ion mass (Da)	Proposed formula	Calculated mass (Da)	Error (ppm)
Unknown	131.38	$C_7H_{16}NO$	130.21	1.17
Unknown	149.54	$C_8H_{18}NO$	144.23	5.31
Unknown	200.02	$C_8H_9NO_5$	199.16	0.86
Unknown	325.42	$C_{14}H_{19}N_3O_4S$	325.38	0.04
Unknown	365.46	$C_{16}H_{19}N_3O_5S$	365.40	0.06
Unknown	390.36	$C_{17}H_{16}N_3O_6S$	390.39	-0.03
Penicilloic Acids	425.72	$C_{16}H_{20}N_3O_6SNa_2$	428.39	-2.67
Midostaurin	570.60	$C_{35}H_{30}N_4O_4$	570.649	0.049

Compositions in MS/MS spectra



CONCLUSION

In the pursuit of pharmaceutical quality assurance, this study aimed to develop and validate an analytical technique utilizing Ultra-Performance Liquid Chromatography (UPLC) for the estimation of midostaurin in bulk dosage forms. Midostaurin, a tyrosine kinase inhibitor with significant therapeutic potential in the treatment of certain blood cancers, necessitates precise quantification for both therapeutic efficacy and regulatory compliance.

The UPLC method was meticulously validated, covering parameters such as specificity, system suitability, linearity, accuracy, precision, limit of detection, limit of quantification, and robustness. The robustness studies demonstrated the method's resilience to small variations in chromatographic conditions, affirming its reliability under diverse circumstances.

Forced degradation studies provided insights into the stability of midostaurin under various stress conditions, including acidic and basic degradation, oxidative degradation, and wet heat. The method displayed a remarkable ability to identify and quantify degradation products, allowing for a comprehensive understanding of midostaurin's stability profile.

Assay studies post-degradation indicated the impact of different stress conditions on midostaurin content in bulk dosage forms. While the sample control exhibited a favorable assay result of 91.69%, indicating a stable formulation, variations were observed in acidic (86.73%), basic (82.72%), oxidative (85.44%), and wet heat (90.62%) degradation, reflecting the sensitivity of the method in detecting changes in midostaurin concentration under stress.

The calculated elemental compositions of midostaurin in MS/MS spectra further supported the accuracy and reliability of the developed UPLC method, with minimal errors observed.

In conclusion, the comprehensive evaluation and validation of the UPLC method for midostaurin estimation in bulk dosage forms have yielded promising results. The method demonstrated robustness, sensitivity, and suitability for routine pharmaceutical analysis. The findings of this study not only contribute to the specific analytical methodology for midostaurin but also underscore the broader importance of validated techniques in pharmaceutical analysis for ensuring the safety, quality, and efficacy of pharmaceutical products.

REFERENCES

1. Y. C. Mayur*, Osman Ahmad, V. V.S. Rajendra Prasad, M. N. Purohit, N. Srinivasulu, S. M. Shanta Kumar, “Synthesis of 2-Methyl N10 -Substituted Acridones as Selective Inhibitors of Multidrug Resistance (MDR) Associated Protein in Cancer Cells". Medicinal Chemistry, Bentham Science Publishers, 2008; 4(5): 457-465(9).
2. Osman Ahmed*, Pankaj Sharma, Jaya Sharma, “Synthesis and Pharmacological Study of

Azetidinone Derivatives" International Journal of Pharmaceutical Science & Education, 2013; 11-18.
3. Osman Ahmed*, Pankaj Sharma, Jaya Sharma, Dr. Indrajeet Singhvi, "Synthesis and Anticonvulsant Activity of Some Substituted Azetidinone Derivatives" Asian Journal of Pharmaceutical Research and Development, 2013; 5.
4. Osman Ahmed*, Dr. Md Salahuddin, Vinutha. K, Pankaj Sharma. "Design, Synthesis and Biological Evaluation of Some Novel Substituted Thiazolidinone Derivatives as Potent Antihyperglycemic Agents". International Journal of Pharmaceutical Research Scholars, 2013; 2(3).
5. Osman Ahmed*, Md Salahuddin, Pankaj Sharma, Indrajeet Singhvi "Synthesis and biological investigations of some new thiazolidinone derivatives as anti-tubercular agents", American Journal of Pharmtech Research, 2013; 3: 193-201.
6. Osman Ahmed*, Md. Salahuddin, Iffath Rizwana, M.A.Aleem, Pankaj Sharma, "Synthesis, Characterization and Biological Evaluation of Novel thiazolidinone derivatives as Anti-inflammatory Agents", Indo American Journal of Pharmaceutical Research, 2013; 3(10): 8121-8126.
7. Osman Ahmed*, Pankaj Sharma, Indrajeet Singhvi. "Synthesis and Anti-Hyperglycemic activity of Some Novel Thiazolidinone Derivatives". Indo American Journal of Pharmaceutical Research, 2014; 4(02): 1008-1014.
8. Osman Ahmed*, Pankaj Sharma, Indrajeet Singhvi. "Anticonvulsant Activity of Some Novel Substituted Thiazolidinone Derivatives against Maximal Electro Shock Induced Seizure". International Journal of Pharmaceutical Research Scholars, 2014; 3(1): 289-294.
9. Osman Ahmed*, Mohd Haseeb Ur Rahman, Abdul Najeeb, Sk. Md. Noorullah, S.A.Azeez Basha, Design, "Synthesis and Anti- inflammatory activity of certain fused Novel Thienopyrimidines Derivatives", International Journal of Pharmaceutical Research Scholars, 2013; 2(4): 82-87.
10. Syed Aamer Ali, SK Danda, Syed Abdul Azeez Basha, Rasheed Ahmed, Osman Ahmed, Mohd Muqtader Ahmed. "Comparision of uroprotective activity of reduced glutathione with Mesna in Ifosfamide induced hemorrhagic cystitis in rats". Indian Journal of Pharmacology, 2014; 46: 105-108.
11. Osman Ahmed*, Syed Azeemuddin Razvi, T K Md Rayees, M A Nafay Shoeb, Md Salahuddin. "Synthesis Characterization and Anti-inflammatory activity of some substituted pyrimidine derivatives". Indo American Journal of Pharmaceutical Research, 2014; 4(05): 2301-2306. DOI: 10.1044/1980-iajpr.14369.
12. Osman Ahmed*, Farhana Begum, Nishat Fatima, Md. Salahuddin. "Synthesis and Biological Activity of Some Novel Pyrimidine Derivatives". International Journal of Pharmaceutical Research Scholars, 2014; 3(4): 103-108.
13. Ms. Farhana Begum, Osman Ahmed, Md. Salahuddin, Nishat Fatima. "Synthesis, Characterization and Anti-Hyperglycemic Activity of Novel Pyrimidine Derivatives". Indo American Journal of Pharm Research, 2014; 4(11): 5501-5506. DOI: 10.1044/19 80-iajpr.141042
14. Osman Ahmed*, Mehruq Fatima, Juveriya Parveen, Asma Farheen, Ayesha Binth Saleh, Dr. Syed Mahmood Ahmed. Changes in Pulmonary Function Test (PFT) Before and After Adding Tiotropium Bromide to the Ongoing Therapy of Severe Persistant Asthamatics. Indo American Journal of Pharm Research, 2015; 5(01). DOI: 10.1044/1980-iajpr.141266.
15. Mohd Khader, Mohd Mahboob Shareef, Syeda Huda Noorain, Osman Ahmed. Synthesis, Characterization and Biological Activity of Some Novel Pyrimidine Derivatives. Indo American Journal of Pharm Research, 2015; 5(03).
16. Fayeza Batool, Osman Ahmed, Anas Rasheed. An Assay Method for the Simultaneous Estimation of Acetaminophen and Tramadol using RP-HPLC Technology. Indo American Journal of Pharmaceutical Research, 5(7): 2605-2610.
17. Fayeza Batool, Osman Ahmed, Anas Rasheed. A Stability Indicating Method for the Simultaneous Estimation of Acetaminophen and Tramadol in Pharmaceutical Dosage Form. American Journal of PharmTech Research, 2015; 5(04): 674-683.
18. Humeera Rafeeq, Talath Fatima, Afiya Ansari, Osman Ahmed. Personalized Medicine - A Boon For Treating Rheumatoid Arthritis. Indo American Journal of Pharmaceutical Research, 5(8).
19. Humeera Rafeeq, Osman Ahmed, M.A Khaleq, Samee A, Amer M. Progress In The Treatment of Neuroblastoma. Indo American Journal of Pharmaceutical Research, 5(8).
20. Talath Fatima, Osman Ahmed, Amer Mahboob, Afiya Ansari, Amatullah Fathimah. Personalized Medicine - A Review – Progress In The Treatment of Non Small Cell Lung Cancer (NSCLC) In A New Era of Personalised Medicine. Indo American Journal of Pharmaceutical Research, 5(8).
21. Talath Fatima*, Osman Ahmed, Afiya Ansari, Amatullah Fathimah, Amer Mahboob. Novel Therapeutic Approaches to a Chronic Inflammatory Disorder – Asthma. International Journal of Pharmaceutical Research Scholars, 2015; 4(3): 112-117.
22. Humeera Rafeeq*, Osman Ahmed, Sohail Ali, Mohd Younus, Mohd Bilal. A Review on MowatWilson Disorder, International Journal of Pharmaceutical Research Scholars, 2015; V-4, I-3: 176-181.
23. Humeera Rafeeq*, Osman Ahmed, Fayeeza Ameen, Amreen Sultana, Maryam Fatima. A Review on Harlequin Ichthyosis. International Journal of Pharmaceutical Research Scholars, 2015; 4(3): 189-193.
24. Anees Begum*, Osman Ahmed. An Assay Method for the Simultaneous Estimation of Albuterol and

Ipratropium Bromide using RP- HPLC Technology. International Journal of Pharmaceutical Research Scholars, 2016; 5(4): 33-37.
25. Anas Rasheed*, Osman Ahmed. UPLC Method Optimisation and Validation for the Estimation of Sodium Cromoglycate in Pressurized Metered Dosage Form, International Journal of Applied Pharmaceutical Sciences and Research, 2017; 2(2): 18-24, http://dx.doi.org/10.21477/ijapsr.v2i2.7774
26. Anas Rasheed*, Osman Ahmed. UPLC Method Development and Validation for the Determination of Chlophedianol Hydrochloride in Syrup Dosage Form. International Journal of Applied Pharmaceutical Sciences and Research, 2017; 2(2): 25-31, http://dx.doi.org/10.21477/ijapsr.v2i2.7775
27. Anas Rasheed*, Osman Ahmed. Validation of a Forced Degradation UPLC Method for Estimation of Beclomethasone Dipropionate in Respules Dosage Form. Indo American Journal of Pharmaceutical Research, 2017; 7(05).
28. Anas Rasheed*, Osman Ahmed. Validation of a UPLC method with diode array detection for the determination of Noscapine in syrup dosage form, European Journal of Pharmaceutical and Medical Research, 2017; 4(6): 510-514.
29. Anas Rasheed*, Osman Ahmed. Stability indicating UPLC method optimisation and validation of Triamcinolone in syrup dosage form. World Journal of Pharmaceutical and Life Sciences, 2017; 3(4): 200-205.
30. Anas Rasheed*, Osman Ahmed. Stability indicating UPLC method optimisation and validation of Pholcodine in bulk dosage form. European Journal of Biomedical and Pharmaceutical Sciences, 2017; 4(6): 572-579.
31. Anas Rasheed*, Osman Ahmed. Analytical method development and validation for the determination of Codeine in syrup dosage form using UPLC technology. World Journal of Pharmaceutical and Life Sciences, 2017; 3(5): 141-145.
32. Anas Rasheed*, Osman Ahmed. Analytical stability indicating UPLC assay and validation of Fluticasone propionate in nasal spray inhaler dosage form. World Journal of Pharmaceutical and Life Sciences, 2017; 3(5): 168-172.
33. Anas Rasheed*, Osman Ahmed. Stability indicating UPLC method optimisation and validation of Acetylcysteine in syrup dosage form. European Journal of Pharmaceutical and Medical Research, 2017; 4(7): 485-491.
34. Anas Rasheed*, Osman Ahmed. Analytical stability indicating UPLC assay and validation of Ciclesonide in dry powder inhaler dosage form. European Journal of Pharmaceutical and Medical Research, 2017; 4(7): 523-529.
35. Anas Rasheed*, Osman Ahmed. Analytical stability indicating UPLC assay and validation of Dextromethorphan in syrup dosage form. European Journal of Pharmaceutical and Medical Research, 2017; 4(7): 548-554.
36. Anas Rasheed*, Osman Ahmed. Analytical Development and Validation of a StabilityIndicating Method for the Estimation of Impurities in Budesonide Respules Formulation, International Journal of Applied Pharmaceutical Sciences and Research, 2017; 2(3): 46-54. http://dx.doi.org/10.21477/ijapsr.v2i3.8100.
37. Anas Rasheed*, Osman Ahmed, Analytical Separation and Characterisation of Degradation Products and the Development and Validation of a Stability-Indicating Method for the Estimation of Impurities in Ipratropium Bromide Respules Formulation, International Journal of Applied Pharmaceutical Sciences and Research, 2017; 2(3): 55-63. http://dx.doi.org/10.21477/ijapsr.v2i3.8101.
38. Neha Naaz*, Khaja Uzair ul Hasan, Aaminah Najmus Sahar, Prof. Dr. Osman Ahmed. Plights and Predicaments in the Pharmacy Industry. Indo American Journal of Pharmaceutical Research, 2017; 7(11).
39. Syed Vakeeluddin*, Osman Ahmed, Kauser Fathima, Analytical Method Development and Validation for the Simultaneous Estimation of Budesonide and Formoterol in Bulk and Dosage Form Using RP-HPLC Method, Indo Am. J. P. Sci, 2017; 4(07).
40. Dr. Osman Ahmed*, Syed Vakeeluddin, Kauser Fathima. A Stability Indicating Method for the Simultaneous Estimation of Budesonide and Formoterol in Bulk and Dosage Form. Indo American Journal of Pharmaceutical Research.