ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 14, Issue 2, 2021

Online - 2455-3891
Print - 0974-2441

Research Article

STABILITY INDICATING METHOD DEVELOPMENT AND VALIDATION OF FIMASARTAN BY REVERSE-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY IN BULK AND PHARMACEUTICAL DOSAGE FORM

SRUTHI A*, UTTAM PRASAD PANIGRAHY

Department of Pharmaceutical Analysis, CMR College of Pharmacy, Hyderabad, Telangana, India. Email: uttampanigrahy@gmail.com

Received: 23 October 2020, Revised and Accepted: 2 December 2020

ABSTRACT

Objective: A rapid, sensitive and specific reverse phase High performance liquid Chromatography (RP-HPLC) method was developed for the estimation of Fimasartan in bulk and pharmaceutical dosage form.

Method: The RP-HPLC analysis was performed isocratically on a Primacel C_{18} column (150 mm × 4.6 mm internal diameter, 5 µm particle size) using mobile phase of composition Acetonitrile and 0.1% orthophosphoric Acid in 80:20, v/v proportions with a flow rate of 0.8 ml/min.

Results: The analyte was monitered with UV-detector at 265 nm. In the developed method Fimasartan elutes at a typical retention time of 2.4 min. The proposed method is having linearity in the concentration ranging from 5-30 µg/ml of Fimasartan.

Conclusion: : The method was statistically validated and had been applied to analysis of the drug in bulk and pharmaceutical dosage form.

Keywords: Fimasartan, Reverse-phase high-performance liquid chromatography, C_{18} column.

 DOI: http://dx.doi.org/10.22159/ajpcr.2021v14i2.39919. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

Fimasartan is a typical anti-hypertensive agent. Fimasartan acts on the kidney's rennin-angiotensin cascade, which begins when renin release from the kidney causes the breakdown of angiotensinogen into angiotensin I. In blocking the AT_1 receptor, Fimasartan inhibits vasoconstriction favoring vasodilation. Fimasartan is chemically known as 2-[2-butyl-4-methyl-6-oxo-1-[[4-[2-(2*H*-tetrazol-5-yl) phenyl] phenyl] methyl] pyrimidin-5-yl]-*N* and *N*-dimethylethanethioamide shown in Fig. 1.

Literature survey reveals the availability of few methods such as ultraviolet (UV), high-performance liquid chromatography (HPLC), and LC-MS in biological fluids and pharmaceutical dosage forms [1-16]. The present method gives the accurate information regarding method development and validation of Fimasartan in bulk and pharmaceutical dosage form using UV detector at 265 nm which is simple, accurate, economic, rapid, reproducible, and sensitive according to procedures and acceptance criteria based on FDA guidelines and recommendations of ICH.

METHODS

Chemical and reagents

Fimasartan was procured as gift sample from Metrochem Pvt. Ltd., Hyderabad, India. Fimanta® 120 mg (formulation) was manufactured by Ajanta Pharma Limited. HPLC grade acetonitrile, HPLC grade water, and orthophosphoric acid were obtained from Merck, Hyderabad, India. All other chemical reagents used were of analytical grade.

Selection of wavelength

Wavelength was selected by dissolving Fimasartan in suitable solvent (acetonitrile) and the resulting solution was scanned in UV region, that is, 200–400 nm. Fimasartan has showed that maximum absorption at 265 nm was selected shown in Fig. 2.

Chromatographic conditions

A Shimadzu HPLC was used for the analysis of the entire method. The method was carried out on Primacel C_{18} (150 mm × 4.6 mm i.d., 5 µm) column as a stationary phase and Acetonitrile:0.1% OPA (80:20,v/v) as the mobile phase at a flow rate of 0.8 ml/min. Rheodyne injector with 25 µl loop was used for injecting the samples. Finally, the sample was analyzed at 265 nm and the mobile phase was sonicated filtered and degassed.

Preparation of mobile phase

Acetonitrile and 0.1% OPA in the ratio of 80:20 v/v were used as a mobile phase for present study which is prepared by dissolving 80 ml of acetonitrile and 20 ml of 0.1% OPA in a reservoir. 0.1% orthophosphoric acid was prepared by accurately measuring of 0.1 ml of OPA and dissolving in 100 ml of HPLC grade water. The above mobile phase prepared is sonicated and degassed.

Preparation of standard solution

Standard solution was prepared by accurately weighing 100 mg of Fimasartan and transferring into 100 ml volumetric flask. To this add few ml of acetonitrile and dissolve the drug properly. Finally make up the solution to 100 ml with acetonitrile (1000 µg/ml).

Preparation of sample solution

Tablet powder equivalent to 100 mg of Fimasartan was accurately weighed and transferred into 100 ml volumetric flask and make up the volume to 100 ml with acetonitrile. Sonicate the solution for about 15 min and filter the solution through Whatman filter paper (No. 1) into another 100 ml volumetric flask (1000 µg/ml). The solution was further diluted with the diluent to the working concentration range of calibration curve.

Calibration curve

Ten milliliters of standard solution were transferred into 100 ml volumetric flask and the volume was made up to 100 ml using acetonitrile (100 µg/ml). From this solution, further dilutions were made in the concentration range of 5 µg/ml–30 µg/ml. Further these concentrations were injected thrice into the system and the calibration curve was constructed by plotting concentration on X-axis and peak area on Y-axis.

Assay procedure for the commercial formulation

Fimasartan is available as film coated tablets containing equivalent amount of Fimasartan potassium trihydrate. Fimasartan is available in the local market with brand names FIMANTA (120 mg, Ajanta Pharma Limited, India). 1000 µg/ml of sample solution which was prepared and further diluted to 10 µg/ml and was injected into HPLC system and the % assay was calculated and the values are given in Table 1.

RESULTS AND DISCUSSION

Specificity

The blank prepared from the formulation excipients was injected into the system. No peaks were detected in the retention time corresponding to analyte peak, which indicates that no interference of excipients of the formulation which indicates that the method developed is having the specificity. The standard and blank chromatogram is given in Fig. 3.

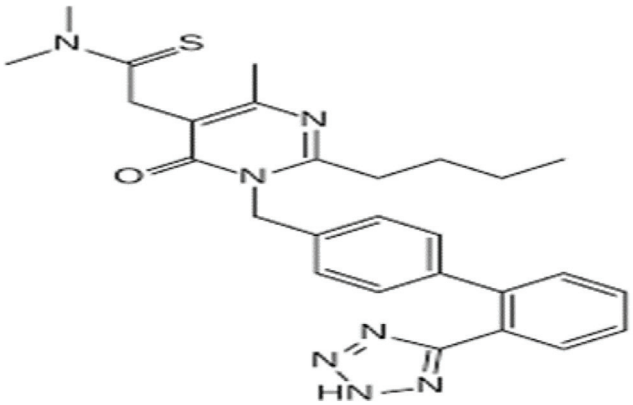

Fig. 1: Chemical structure of Fimasartan

Linearity

Ten milliliters of standard solution were transferred into 100 ml volumetric flask and the volume was made up to 100 ml using acetonitrile (100 µg/ml). From this solution, further dilutions were made in the concentration range of 5 µg/ml–30 µg/ml. Further these concentrations were injected thrice into the system and the calibration curve was constructed by plotting concentration of Fimasartan on X-axis and mean peak area on Y-axis. The method is having good linearity (r^2 = 0.9995). The linearity graph and table were given in Table 2 and Fig. 4.

Limit of detection (LOD)

This is the smallest concentration of analyte which can be detected. This can be calculated using the following formula:

LOD= 3.3 × Standard deviation/slope

By calculating, it was found as 1.3 µg/ml.

Table 1: Assay of tablet formulation

Drug	Fimanta ®tablet label claim (mg)	Amount found (mg)	% Label claim±% RSD (n=3)
Fimasartan	120	119.95	99.96±0.13

Table 2: Linearity table of Fimasartan

Concentration (µg/ml)	Peak area (mV)
5	317.684
10	625.400
15	894.706
20	1176.303
25	1476.828
30	1749.634

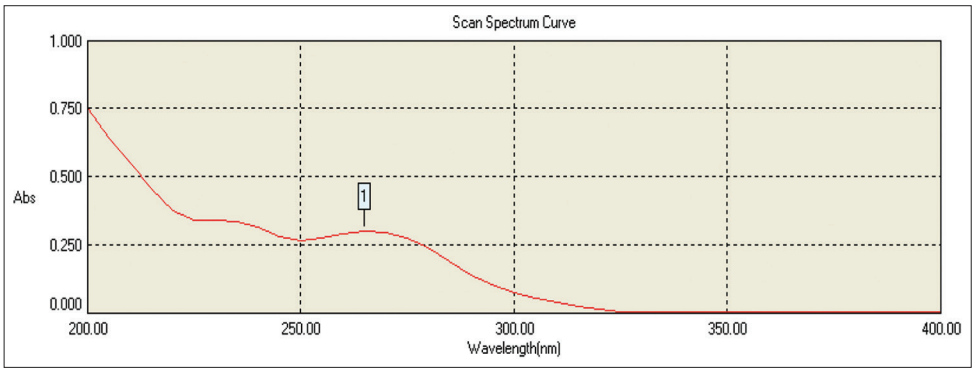

Fig. 2: Ultraviolet spectra of Fimasartan

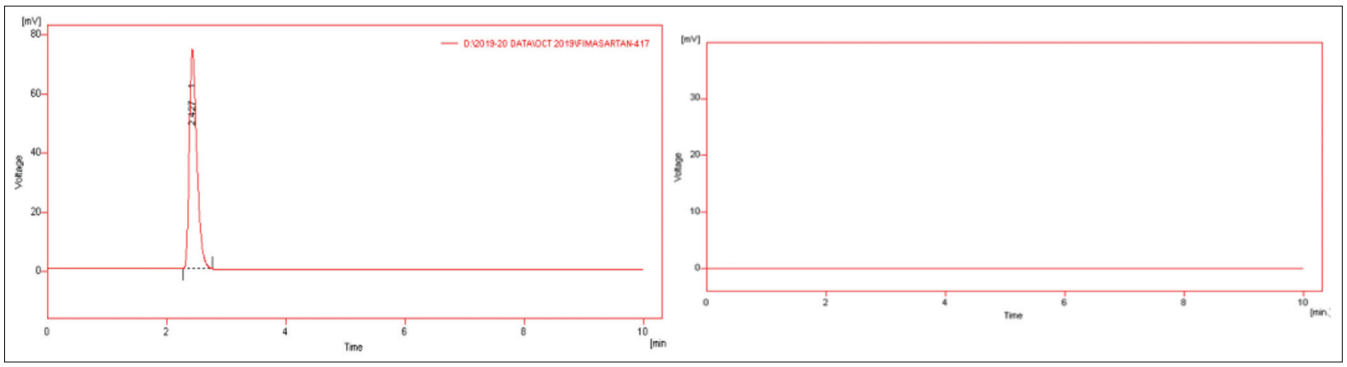

Fig. 3: Blank and standard chromatogram of Fimasartan

Limit of quantification (LOQ)

This is the lowest concentration of analyte which can be quantified. This can be calculated using the following formula:

LOD= 10 × Standard deviation/slope

By calculation it was found as 4 µg/ml.

Accuracy

It is an agreement between the true value and the measured value. Accuracy is performed by injecting 50%, 100%, and 150% levels for 3 times into HPLC system. Finally, the amount found, amount added, %recovery, mean recovery, %SD, and %RSD were calculated and are clearly illustrated in Table 3 which indicates that the obtained results are in good agreement between each other.

Precision

Repeatability

System precision

This is performed by injecting 10 µg/ml of standard solution 6 times into HPLC system note down the peak areas and calculates the average, SD, and %RSD which is clearly illustrated in Table 4 and Fig. 5.

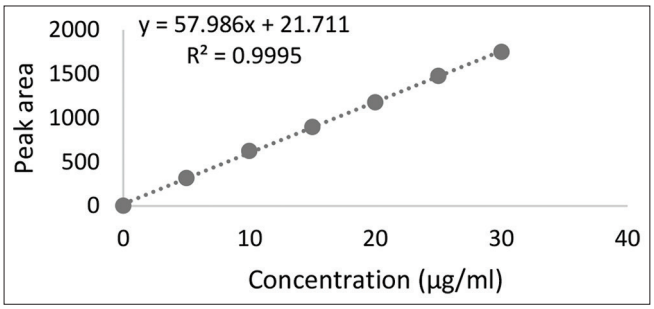

Fig. 4: Linearity curve of Fimasartan

Method precision

This is performed by injecting 10 µg/ml of sample solution six times into HPLC system note down the peak areas and calculates the %assay, average, SD, and %RSD which is clearly illustrated in Table 5 and Fig. 6.

Intermediate precision/Ruggedness

It is performed on two different days and by two different analysts and in two different labs by maintaining the same conditions within the laboratories was shown in (Fig. 7).

Analyst-1: Inject the 100% concentration of sample (i.e., 10 µg/ml) for 6 times into HPLC system and note down the area for each and every injection and calculate the SD and % RSD values which is clearly illustrated in Table 6.

Analyst-2: Inject the 100% concentration of sample (i.e., 10 µg/ml) for six 6 times into HPLC system and note down the area for each and every injection and calculate the SD and % RSD values which is clearly illustrated in Table 6.

Day-1: Inject the 100% concentration of sample (i.e., 10 µg/ml) for 6 times into HPLC system and note down the area for each and every injection and calculate the SD and % RSD values which is clearly illustrated in Table 6.

Day-2: Inject the 100% concentration of sample (i.e., 10 µg/ml) for 6 times into HPLC system and note down the area for each and every injection and calculate the SD and % RSD values which is clearly illustrated in Table 6.

Reproducibility

This is defined as the precision between the labs. It is performed by injecting 100% concentration of sample (i.e., 10 µg/ml) for 6 times into two different HPLC system in two different laboratories and note down the area for each and every injection and calculate the SD and % RSD values which is clearly illustrated in Table 7 and Fig. 8.

Table 3: Results showing accuracy of Fimasartan

Level (%)	Amount added (µg/ml)	Amount found (µg/ml)	% Recovery	% Avg recovery	% SD	%RSD
50	5	4.98	99.6	99.6	0.2	0.200
50	5	4.97	99.4			
50	5	4.99	99.8			
100	10	9.97	99.7	99.7	0.1	0.100
100	10	9.96	99.6			
100	10	9.98	99.8			
150	15	14.95	99.6	99.70	0.173	0.173
150	15	14.94	99.6			
150	15	14.95	99.6			

Table 4: Results showing system precision values of Fimasartan

Concentration (µg/ml)	Retention time	Peak area (mV)	Average peak area (mV)	SD	%RSD
10	2.4	625.410	626.33	1.34	0.21
10	2.4	626.675			
10	2.4	625.054			
10	2.4	628.253			
10	2.4	627.430			
10	2.4	625.138			

Table 5: Results showing method precision values of Fimasartan

Concentration (µg/ml)	Retention time	Peak area (mV)	%Assay	Average %Assay	S. D	%RSD
10	2.4	627.497	100.10	99.96	0.120	0.120
10	2.4	626.364	99.90			
10	2.4	625.443	99.81			
10	2.4	627.184	100.00			
10	2.4	626.287	99.90			
10	2.4	627.360	100.10			

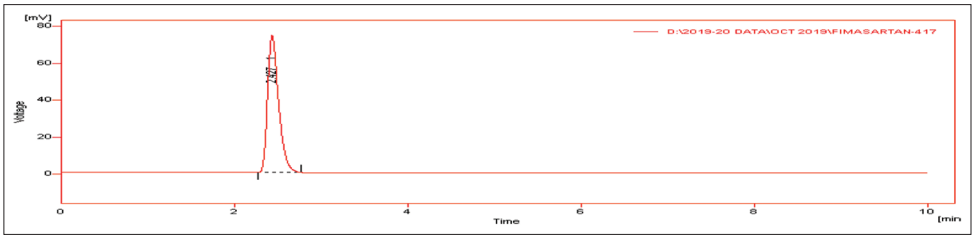

Fig. 5: System precision peak of Fimasartan

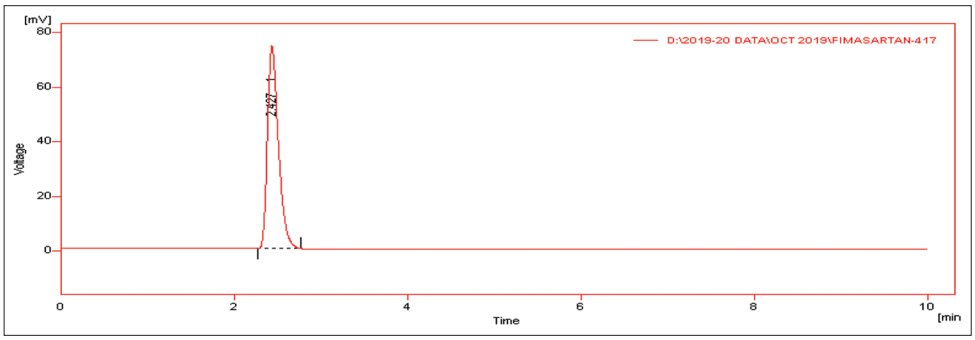

Fig. 6: Method precision peak of Fimasartan

Table 6: Results showing intermediate precision values of Fimasartan

Lab-1 (%Assay)					**Lab-2 (%Assay)**			
Conc. (µg/ml)	**Day-1**		**Day-2**		**Day-1**		**Day-2**	
	A-1	**A-2**	**A-1**	**A-2**	**A-1**	**A-2**	**A-1**	**A-2**
10	100.60	100.10	100.40	100.30	100.40	100.30	100.00	100.10
10	100.20	100.30	99.90	100.00	100.60	100.00	100.30	100.60
10	100.40	100.60	100.30	100.30	100.60	100.30	100.40	100.30
10	100.30	100.30	100.10	100.50	100.30	100.30	100.10	99.90
10	100.50	100.40	100.30	100.60	100.20	100.50	100.10	100.40
10	100.00	100.00	100.60	100.30	100.10	100.00	100.30	100.30
Avg	100.33	100.28	100.27	100.33	100.37	100.23	100.20	100.21
SD	0.22	0.21	0.24	0.21	0.21	0.20	0.15	0.24
%RSD	0.22	0.21	0.24	0.21	0.21	0.20	0.15	0.24
Intermediate precision within laboratory variations (n=6)								
Avg		100.30			Avg		100.27	
SD		0.032			SD		0.072	
%RSD		0.032			%RSD		0.072	

Table 7: Results showing reproducibility values of Fimasartan

Lab-1 (%Assay)		**Lab-2 (%Assay)**	
Avg	100.30	Avg	100.27
SD	0.032	SD	0.072
%RSD	0.032	%RSD	0.072
Reproducibility between laboratories (n=48)			
Avg		100.29	
SD		0.021	
%RSD		0.021	

Robustness

It is defined as a small or deliberate change in parameter should not affect any method. This is performed by change in flow rate (± 10%) and mobile phase (± 10%)

Change in flow rate

This is performed by changing the flow rate of ± 10% (i.e., 0.7 ml/min and 0.9 ml/min). Inject the 100% concentration, that is, 10 µg/ml six 6 times for both the flow rates, that is, 0.7 ml/min and 0.9 ml/min. Note down the peak area and calculate the %assay, average, SD, and %RSD for both the flow rates which is clearly illustrated in Table 8 and Figs. 9 and 10.

Change in mobile phase (+10% organic phase)

This is performed by changing the organic phase proportion of ± 10% (i.e., 88:12 v/v and 72:28 v/v). Inject the 100% concentration, that is, 10 µg/ml 6 times for both the mobile phase proportions, that is, 88:12 v/v and 72:28 v/v. Note down the peak area and calculate the %Assay, Average, SD, and %RSD for both the mobile phase proportions which is clearly illustrated in Table 9 and Figs. 11 and 12.

Solution stability

This is performed for 0 h, 24 h, and 48 h. Inject the 100% concentration, that is, 10 µg/ml for 6 times at 0 h, 24 h, and 48 h. Note down the peak area and calculate the %assay, average, SD, %RSD for both the mobile phase proportions which is clearly illustrated in Table 10 and Figs. 13-15.

Force degradation studies

This includes acid degradation, alkali degradation, oxidative degradation, photolytic degradation, and thermal degradation which are clearly illustrated in Table 11 and Figs. 16-20.

Table 8: Results showing change in flow rate values of Fimasartan

Flow rate (0.7 ml/min)				Flow rate (0.9 ml/min)			
Conc. (µg/ml)	**Rt (mins)**	**Peak area (mV)**	**%Assay**	**Conc. (µg/ml)**	**Rt (mins)**	**Peak area (mV)**	**%Assay**
10	2.7	625.767	99.81	10	2.1	625.296	99.61
10	2.7	623.134	99.41	10	2.1	623.590	99.51
10	2.7	624.620	99.61	10	2.1	625.337	99.71
10	2.7	624.178	99.61	10	2.1	625.176	99.71
10	2.7	623.111	99.41	10	2.1	624.659	99.61
10	2.7	625.376	99.71	10	2.1	623.535	99.51
Mean			99.59	Mean			99.61
SD			0.160	SD			0.089
%RSD			0.161	%RSD			0.089

Table 9: Results showing change in mobile phase values of Fimasartan

Mobile phase −10%				Mobile phase +10%			
Conc. (µg/ml)	**Rt (mins)**	**Peak area (mV)**	**%Assay**	**Conc. (µg/ml)**	**Rt (mins)**	**Peak area (mV)**	**%Assay**
10	2.3	625.767	99.81	10	2.6	625.337	99.71
10	2.3	625.376	99.71	10	2.6	625.176	99.71
10	2.3	624.296	99.61	10	2.6	625.376	99.71
10	2.3	623.590	99.51	10	2.6	624.296	99.61
10	2.3	625.176	99.71	10	2.6	624.659	99.61
10	2.3	623.111	99.41	10	2.6	625.376	99.71
Mean			99.63	Mean			99.68
SD			0.147	SD			0.052
%RSD			0.148	%RSD			0.052

Table 10: Results showing solution stability values of Fimasartan

0 h				24 h		48 h	
Concentration (µg/ml)	**Retention time (mins)**	**Peak area (mV)**	**%Assay**	**Peak area (mV)**	**%Assay**	**Peak area(mV)**	**%Assay**
10	2.4	625.405	99.81	625.402	99.81	623.524	99.51
10	2.4	627.537	100.10	624.785	99.81	625.510	99.81
10	2.4	624.381	99.61	623.607	99.51	624.462	99.61
10	2.4	628.216	100.20	624.324	99.61	623.180	99.41
10	2.4	626.422	99.91	625.924	99.81	624.989	99.71
10	2.4	629.979	100.51	623.170	99.41	625.917	99.81
Mean			100.02	Mean	99.66	Mean	99.64
SD			0.32	S. D	0.18	S. D	0.16
%RSD			0.32	%RSD	0.18	%RSD	0.16

Table 11: Results showing forced degradation values of Fimasartan

Degradation parameter (n=3)	Concentration (µg/ml)	Peak area (mV)	Average peak area (mV)	%Degraded	%Recovered
Acid	10	795.442	794.98	27.2	72.8
	10	794.251			
	10	795.254			
Alkali	10	698.982	698.25	11.6	88.4
	10	697.251			
	10	698.523			
Peroxide	10	983.123	982.83	57.1	42.9
	10	982.145			
	10	983.251			
Thermal	10	624.252	624.54	0.14	99.86
	10	625.124			
	10	624.251			
Photolytic	10	625.124	625.16	0.04	99.96
	10	625.231			
	10	625.145			

Preparation of solutions

a. Preparation of 0.1N HCl (for acid degradation)
Pipette out 0.812 ml of HCl in a 100 ml volumetric flask and make up the volume to 100 ml with distilled water (0.1N).

b. Preparation of 0.1N NaOH (for alkali degradation)
Accurately weigh 0.4 g of sodium hydroxide pellets and transfer into 100 ml volumetric flask and make up the volume to 100 ml with distilled water (0.1N).

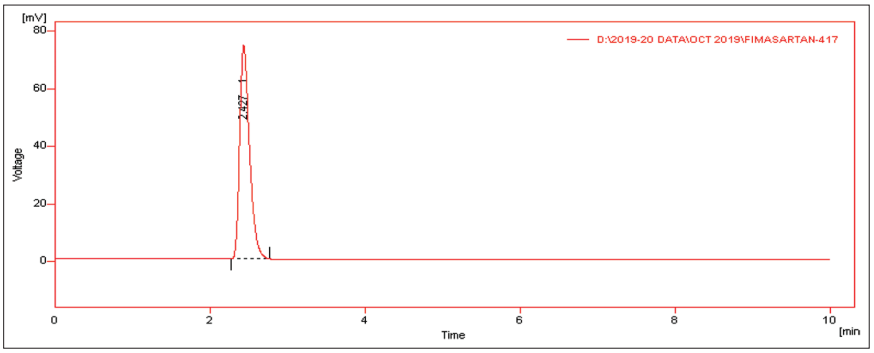

Fig. 7: Intermediate precision peak of Fimasartan

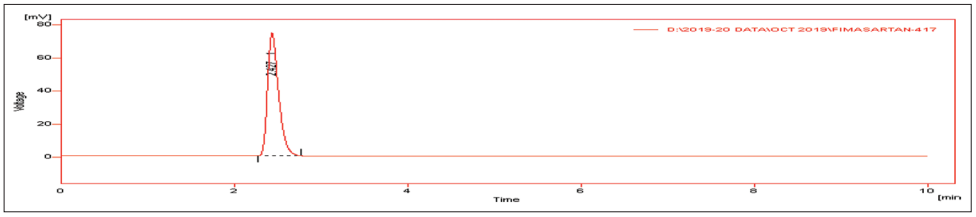

Fig. 8: Reproducibility peak of Fimasartan

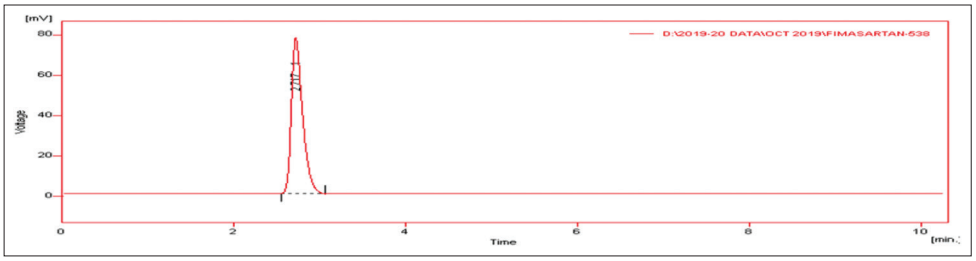

Fig. 9: Peak which was eluted at 0.7 ml/min of flow rate

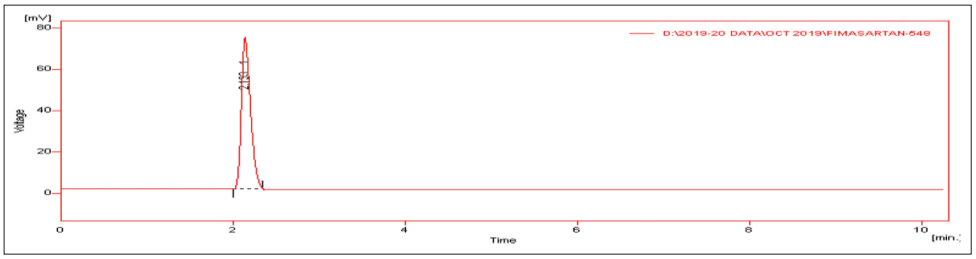

Fig. 10: Peak which was eluted at 0.9 ml/min of flow rate

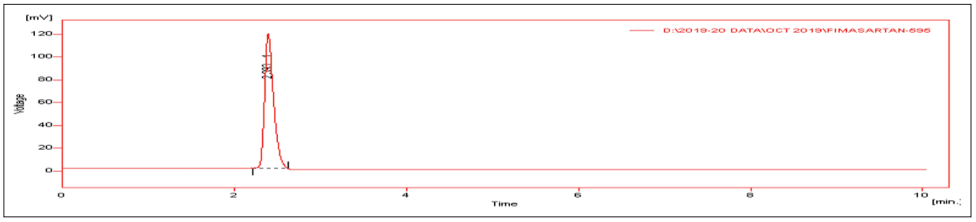

Fig. 11: Peak which was eluted at +10% of mobile phase

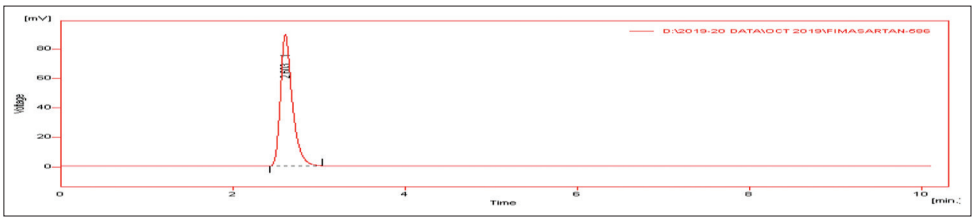

Fig. 12: Peak which was eluted at −10% of mobile phase

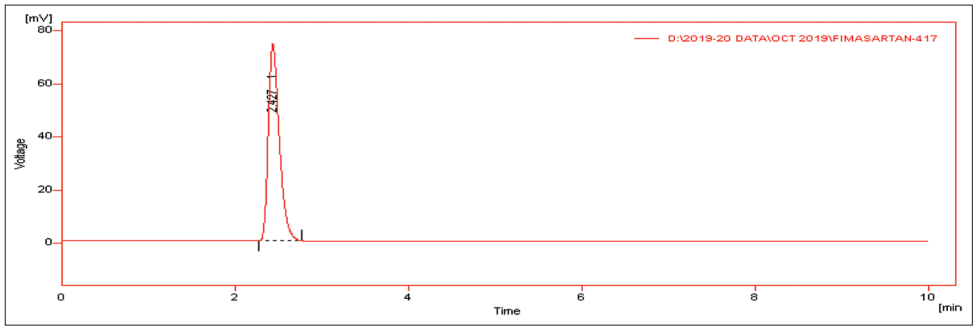

Fig. 13: Peak which was eluted at 0 h

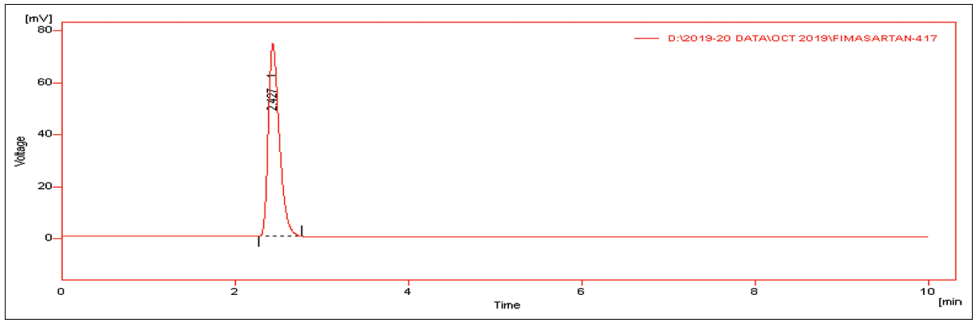

Fig. 14: Peak which was eluted at 24 h

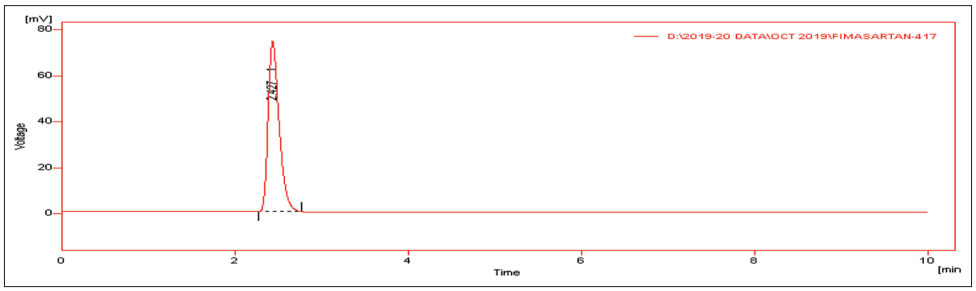

Fig. 15: Peak which was eluted at 48 h

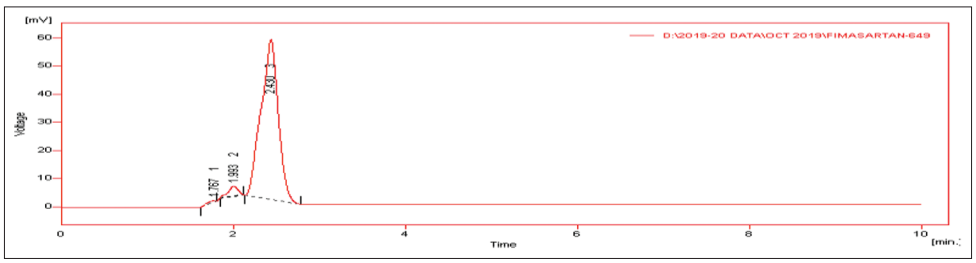

Fig. 16: Peak showing acid degradation

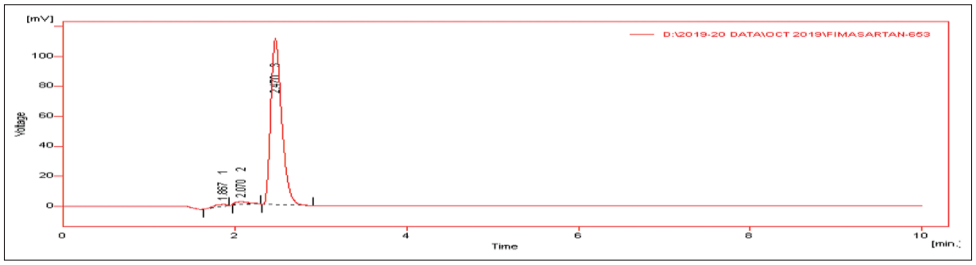

Fig. 17: Peak showing alkali degradation

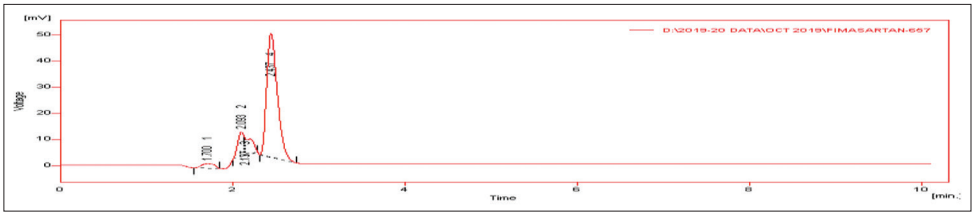

Fig. 18: Peak showing oxidative degradation

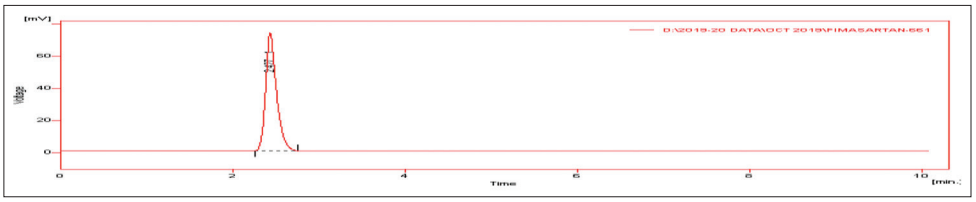

Fig. 19: Peak showing photolytic degradation

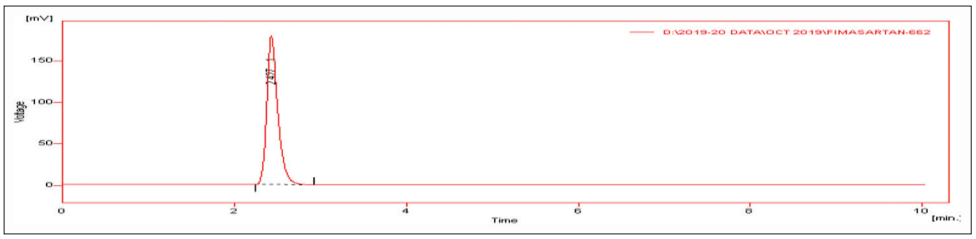

Fig. 20: Peak showing thermal degradation

c. Preparation of 3% H_2O_2 (for oxidative studies)
Pipette out 3 ml of H_2O_2 into a 100 ml volumetric flask and make up the volume to 100 ml with distilled water (3%).

Procedure for FDS studies

a. Acid degradation studies
From 100 µg/ml of stock solution of Fimasartan pipette out 1 ml to this add 1 ml of 0.1N HCl finally make up the solution to 10 ml with ACN and keep it for 60 min and check the peak area by injecting the sample into HPLC system using the optimized mobile phase.

b. Alkali degradation studies
From 100 µg/ml of stock solution of Fimasartan pipette out 1 ml. To this add 1 ml of 0.1N NaOH. Finally make up the solution to 10 ml with ACN and keep it for 60 min and check the peak area by injecting the sample into HPLC system using the optimized mobile phase.

c. Oxidative degradation studies
From 100 µg/ml of stock solution of Fimasartan pipette out 1 ml. To this add 1 ml of 3% H_2O_2 finally make up the solution to 10 ml with ACN and keep it for 60 min and check the peak area by injecting the sample into HPLC system using the optimized mobile phase.

d. Photolytic degradation studies
From 100 µg/ml of stock solution of Fimasartan pipette out 1 ml. Finally make up the solution to 10 ml with ACN. Place the solution in UV cabinet for 60 min. Check the peak area by injecting the sample into HPLC system using the optimized mobile phase.

e. Thermal degradation studies
From 100 µg/ml of stock solution of Fimasartan pipette out 1 ml. Finally make up the solution to 10 ml with CAN. Place the solution in hot air oven for 60 min at 60°C. Check the peak area by injecting the sample into HPLC system using the optimized mobile phase.

Above values clearly illustrates that maximum degradation occurs in peroxide followed by acid and alkali. No degradation occurs in photolytic and thermal.

CONCLUSION

From obtained result, it was concluded that a simple, rapid, sensitive, linear, accurate, rugged, robust, and precise method was developed for the estimation of Fimasartan by HPLC. Various validation parameters such as specificity, linearity, precision, LOD, LOQ, accuracy, solution stability, and forced degradation studies were carried out. The linearity was obtained in the concentration range of 5 µg/ml–30 µg/ml with correlation factor (r^2) 0.999. The %RSD for all the parameters was found to within the limits, that is, <2% and % recovery was also found to within the limits, that is, 98–102%. Hence, it was concluded that the projected method can be used for the determination of Fimasartan by stability indicating and reverse phase HPLC method.

ACKNOWLEDGMENT

I would like to thank our Principal Dr. K. Abbulu, CMR College of Pharmacy, Hyderabad, for providing all the necessary facilities. I express my deepest gratitude to Metrochem Labs Pvt., Hyderabad, for providing API of Fimasartan to facilitate the work. I take my pleasure to thank all the teaching and non-teaching staff members for their valuable support during my academics and project.

AUTHORS' CONTRIBUTIONS

Conceived and designed the experiments: Uttam Prasad Panigrahy. Performed the experiment: A. Sruthi and Uttam Prasad Panigrahy. Analyzed data: Uttam Prasad Panigrahy. All authors read and approved the final manuscript.

CONFLICTS OF INTEREST

The author declared that they have no conflicts of interest.

AUTHOR'S FUNDING

The author(s) received no specific funding for this work.

REFERENCES

1. Sharma BK. Introduction to analytical chemistry. In: Instrumental Methods of Chemical Analysis. Vol. 23. Meerut: Goel Publishing House; 2012. p. 9-303.
2. Pandya CP, Rajput SJ. Validated stability indicating RP-HPLC method for the determination of fimasartan in presence of degradation products. Indo Am J Pharm Res 2017;7:929-46.
3. Moon HW, Yousaf AM, Cho KH, Yong CS. Evaluation of stability and simultaneous determination of fimasartan and amlodipine by a HPLC method in combination tablets. Asian J Pharm Sci 2014;9:123-8.
4. Mohammed AB, Rudwan EH. RP-HPLC method development and validation of stability indicating method a for estimation of losartan potassium under stress condition and tablet dosage form. Int J Pharm Sci Res 2016;7:2343-51.
5. Sumithra M, Shanmugasundaram P, Sankar AS, Niharika. Method development and validation of losartan potassium by RP-HPLC. Res J Pharm Biol Chem Sci 2012;3:463-78.
6. Paladugu ND, Rao GD, Satyanarayana B, Poloju D. Development and validation of RP-HPLC method for quantification of valsartan and its pharmaceutical formulations. Int J Drug Dev Res 2013;5:199-205.
7. Pal R, Padma S, Bhargav Y, Reddy GR. RP-HPLC method development and validation of valsartan in bulk and its tablet dosage form. J Biomed Pharm Sci 2019;2:122.
8. Vinzuda DU, Sailor GU, Sheth NR. RP-HPLC method for determination of valsartan in tablet dosage form. Int J ChemTech Res 2010;2:1461-7.
9. Haque MA, Amrohi SH, Kumar KP, Nivedita G, Kumar TP, Mohanty D, *et al*. Stability indicating RP-HPLC method for the estimation of valsartan in pharmaceutical dosage form. IOSR J Pharm 2012;2:12-8.
10. Siddiqui MM, Qasim SS, Abueida EY. Isocratic RP-HPLC method validation and verification of losartan potassium in pharmaceutical formulations with stress test stability for drug substance. Der Pharm Lett 2011;3:160-7.
11. Panigrahy UP, Kumari KN, Reddy T, Abbulu K. RP-HPLC method development and validation for simultaneous estimation of prazosin and polythiazide in bulk and pharmaceutical dosage form. Res J Pharm Technol 2020;13:1779-89.
12. Masthanamma SK, Pradeepthi, Jahnavi. Stability indicating RP-HPLC method for determination of azilsartan medoxomil in pharmaceutical dosage form. Res J Pharm Technol 2014;7:168-72.
13. Bhadoriya U, Dhaked H, Danodia AK. RP-HPLC method development and validation for estimation of telmisartan in bulk and tablet dosage form. Int J Drug Regul Aff 2013;1:61-4.
14. Raghu Babu K, Sarma ES, Kumari NA, Raju GM, Sarma GV. Simple and stability indicating RP-HPLC assay method development and validation of telmisartan in bulk and dosage form. Der Pharm Lett 2015;7:274-80.
15. Patro SK, Kanungo SK, Patro VJ, Choudhury NS. Stability indicating RP-HPLC method for determination of valsartan in pure and pharmaceutical formulation. J Chem 2009;7:487197.
16. Kore RS, Mahaparale SP, Bhagat AP. Stability indicating RP-HPLC method development and validation for estimation of azilsartan medoxomil in tablet dosage form. World J Pharm Res 2019;8:1023-35.