



Rp-HPLC Method Development and Validation for Simultaneous Estimation of Atorvastatin Calcium and Fenofibrate in Bulk and Formulation

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

A reverse phase high performance liquid chromatographic method was developed for the simultaneous determination of atorvastatin and Fenofibrate in bulk and pharmaceutical dosage forms. The determination was performed by using Waters Symmetry C18 (250×4.6mm×5μ) as column stationary phase and Methanol: Acetonitrile: Water in the ratio of (70:10:20 %v/v) as mobile phase. The flow rate of mobile phase was optimized as 1mL/min and effluents were monitored at 274 nm. The retention time of atorvastatin and Fenofibrate were found as 4.15 min and 8.10 min respectively. The method shows linearity concentration ranges between 4-30 μg/mL and 80-400 μg/mL respectively. The developed method was validated for specificity, precision, linearity, accuracy, robustness, Ruggedness, LOD and LOQ. Recovery of atorvastatin and Fenofibrate in formulations was found to be 100.52% and 99.92% respectively which conforms the non-interferences of the excipients in the formulation. the proposed RP- HPLC method can be used for the simultaneous determination of these two drugs in bulk and formulation.

Keywords: Atorvastatin calcium; validation; fenofibrate; robustness; validation.

1. INTRODUCTION

Atorvastatin calcium 1-4 (AT) is (β R, δ R)-2-(4-fluorophenyl)- β , δ -dihydroxy-5-(1-methyl ethyl)-3-phenyl-4-((phenyl amino) carbonyl)-1H-pyrrole-1-hepatonic acid, a HMG CoA reductase inhibitor. Fenofibrate (FB) is 2-[4-(4-chlorobenzoyl) phenoxy]-2-methylpropanoic acid, 1-methylethyl ester, it is a lipid lowering agent. (Bhinge, Malipatil, 2012) Literature survey reveals that, few HPLC and HPTLC methods have been reported for simultaneous estimation of ATR and FB as well as in combination with other drugs [1]. Has reported HPLC method for simultaneous estimation of ATR and FB using Methanol-Acetonitrile: Phosphate Buffer pH 5.0 (45:25:30 V/V) as eluting solvent. The methods reported by Kadav [2] were excluding the internal standard, which was found to be the limitation of the method. Literature survey also revealed number of UV-VIS spectroscopic [3]. NP-HPLC, RP-HPLC [4] GC and some electro-analytical methods for estimation of these drug alone or in combination with other drugs [5-17].

2. MATERIALS AND METHODS

Quantitative HPLC was performed on a high-performance liquid chromatograph -Waters HPLC system connected with PDA Detector and Empower 2 Software. The drug analysis data were acquired and processed using Empower2 software running under Windows XP on a Pentium PC and C18column of dimension 250 x 4.6, 5 μ m particle size.

2.1 Preparation and Selection of Mobile Phase

The preliminary isocratic studies on a reverse phase C18 column with different mobile phases like Acetonitrile, Methanol and Distilled water different buffers were tried. After some trials the mobile phase was optimized as follows.

A mixture of 70 volumes of Methanol, 10 volumes of Acetonitrile and 20 volumes of Water was used as mobile phase. The mobile phase was filtered through 0.45 μ m membrane filter to remove all fine particles and ultra-sonicated for 10min to remove dissolved gases [17].

2.2 Preparation of Standard Solution

Preparation of standard stock solutions of Fenofibrate and atorvastatin: Weigh accurately 10 mg of Fenofibrate and atorvastatin (Working standard) in to a 100 ml volumetric flask and

dissolved in Methanol and then dilute up to the mark with methanol this solution was further diluted to get desired concentration range.

2.3 Preparation of Sample Solution

Weigh accurately powder equivalent to 16 μ g/ml of Fenofibrate and 1mg of atorvastatin and transfer to 10ml volumetric flask. Then add enough mobile phase to dissolve the content by vigorous shaking or subjected to sonication and make up the final volume up to the mark with mobile phase. Then filter the resulting solution through whattman filter paper.

From the above solution pipette out required aliquots and dilute with mobile phase to prepare the solution containing the concentration of 160 μ g/ml of Fenofibrate and 10 μ g/ml of atorvastatin. This solution was used for recording the chromatogram.

2.4 Chromatographic Conditions

The mobile phase methanol: Acetonitrile : Water in the ratio of 70: 10: 20 v/v was pumped at a flow rate of 1 mL /min through the waters symmetry (250x4.6x5 μ) column at room temperature. The mobile phase was degassed prior to use under vacuum by filtration through a 0.45 μ m membrane filter. Both drugs showed high absorbance values at 274 nm, which was selected as wavelength for further analysis.

2.5 System Suitability Study

System suitability study of the method was carried out by six replicate analysis of solution containing 100% target concentration of atorvastatin and Fenofibrate. Various chromatographic parameters such as retention time, peak area tailing factor, theoretical plates (Tangent) of the column and resolution between the peaks were determined and the method was evaluated by analysing these parameters (Table 2).

2.6 Validation of Developed Analytical Method [18-22]

Linearity: Linearity of the method was determined by constructing calibration curves. Standard solutions of atorvastatin and Fenofibrate of different concentrations level were used for this purpose. Each measurement was carried out in six replicates and the peak areas of

the chromatograms were plotted against the concentrations to obtain the calibration curves and correlation coefficients.

Accuracy (Recovery Studies): To check the degree of accuracy of the method, recovery studies were performed in triplicate by standard addition method at 80%, 100% and 120%. Known amounts of standard drugs were added to pre-analyzed samples and were subjected to the proposed HPLC method. The measured value was obtained by recovery test. Spiked amount of both the drugs were compared against the recovery amount. % recovery was 100.52% for atorvastatin and 99.92% for Fenofibrate (Table 3 and 4).

Precision: Precision was evaluated by carrying out six independent sample preparation of a single lot of formulation. The sample solution was prepared in the same manner as described in sample preparation

Robustness of Method: To evaluate the robustness of the developed RP-HPLC method the prepared solution as per the test method was injected at different variable conditions like using different conditions flow rate and wavelength. (Table 5)

Limit of detection and limit of quantification: The limit of detection (LOD) and limit of quantification (LOQ) of the drug were calculated using the following equations as per International Conference of Harmonization (ICH) guidelines. (Table 6)

$$\text{LOD} = 3.3 \times \alpha / S$$

$$\text{LOQ} = 10 \times \alpha / S$$

3. RESULTS AND DISCUSSION

Development and optimization of the method Column chemistry, solvent type, solvent strength, detection wavelength and flow rate were varied to determine the chromatographic conditions giving the best separation. Separation with good resolutions was studied on different type's columns (C8 and C18). The mobile phase conditions were optimized so that the components were not interfered from the solvent and excipients. Several buffer systems at different pH values were trailed in various ratios with methanol, and acetonitrile as mobile phase. Mobile phase and flow rate selection was based on peak parameters like area, tailing, theoretical plates, capacity factor and resolution. Decisively after several experimental trials, the best result was obtained by use of phase methanol:

Acetonitrile: Water in the ratio of 70: 10: 20 v/v with 1.0 mL/min flow rate.

System suitability parameters like number of plates, asymmetry factor, resolution was found within the specified values suggested by regulatory guidelines seen in Table 1.

The developed method was validated as per the parameters like System suitability parameters, linearity, precision, accuracy, robustness, and the values all above parameters are within the limit so the developed method was validated according to ICH guidelines. Linearity was determined based on value of the correlation coefficient for standard preparations of atorvastatin and Fenofibrate which was found to be 0.999 and 0.999 respectively. The relationship between the concentration of atorvastatin and Fenofibrate and area atorvastatin and Fenofibrate was linear in the range examined since all points lie in a straight line and the correlation coefficient was well within limits. Limit of Detection and limit of quantitation was calculated based on the values of slope obtained from calibration curve. (Table 2).

Precision of the method for intra- day study was evaluated based on relative standard deviation and Percentage relative standard deviation (%RSD) which was found to be less than 2% for within a day variation, which proves that method is precise. (Table 3).

Accuracy of the developed method was evaluated based on recovery studies and mean percentage recovery value for each drug was found within 98-102% range which shows that there is no interference of excipients on the results. The mean percentage recovery of Atorvastatin and Fenofibrate was 100.53% and 99.92% respectively. (Tables 4 and 5).

Robustness of the method was evaluated by some small and deliberate changes in the operating conditions and effect was evaluated with relative standard deviation. Values of relative standard deviation shown in Table 5 suggests that there is no major effect of change in operating conditions.

Developed method was used for analysis of commercial formulation and amount of drug obtained by the method was checked with the label claim amount and assay value was found to be 99.50 and 99.87% for atorvastatin and fenofibrate respectively. (Table 6)

Table 1. Details of system suitability studies

Drug		Retention time (min)	Peak area	Theoretical plates	Tailing factor	Resolution
Atorvastatin	Mean	4.148	5205.26	4046.5	1.58	3.7
	SEM	0.0110	2.9699	0.9955	0.0360	
	%RSD	0.17	0.88	1.72	0.020	
Fenofibrate	Mean	8.104	6337.24	6532.13	1.78	
	SEM	0.0017	0.2483	0.4000	0.0152	
	% RSD	0.0370	0.0067	0.0106	1.5118	

Table 2. Results of LOD and LOQ

Parameter	Atorvastatin	Fenofibrate
LOD	0.32	58
LOQ	0.76	73

Table 3. Results of precision study

Atorvastatin	Fenofibrate	Atorvastatin	Fenofibrate
5	80	5.07	80.08
5	80	5.08	80.12
5	80	5.04	80.07
5	80	5.06	80.14
5	80	5.03	80.19
5	80	5.02	80.05
	Mean	5.05	80.10
	SEM	0.0096	0.0212
	RSD	0.0236	0.0519
	%RSD	0.4686	0.0648

Table 4. Results of accuracy for atorvastatin

Amount of sample taken ($\mu\text{g/ml}$)	Amount of standard added ($\mu\text{g/ml}$)	% of Std. added	Amount recovered ($\mu\text{g/ml}$)	% Amount recovered	% RSD
10	08	80	7.94	99.25	0.74
10	10	100	10.17	101.7	1.25
10	12	120	12.08	100.66	0.97

Table 5. Results of accuracy for fenofibrate

Amount of sample taken ($\mu\text{g/ml}$)	Amount of standard added ($\mu\text{g/ml}$)	% of Std. added	Amount recovered ($\mu\text{g/ml}$)	% Amount recovered	% RSD
16	12.8	80	12.81	100.07	1.22
16	16	100	15.97	99.81	1.08
16	19.2	120	19.18	99.89	0.59

Table 6. Results of robustness

Robustness		Atorvastatin	Fenofibrate
% RSD (Rt)		0.37	0.28
Area*	Change in Flow rate	4205.27	6393.67
	Change Wavelength	4200.89	6389.54

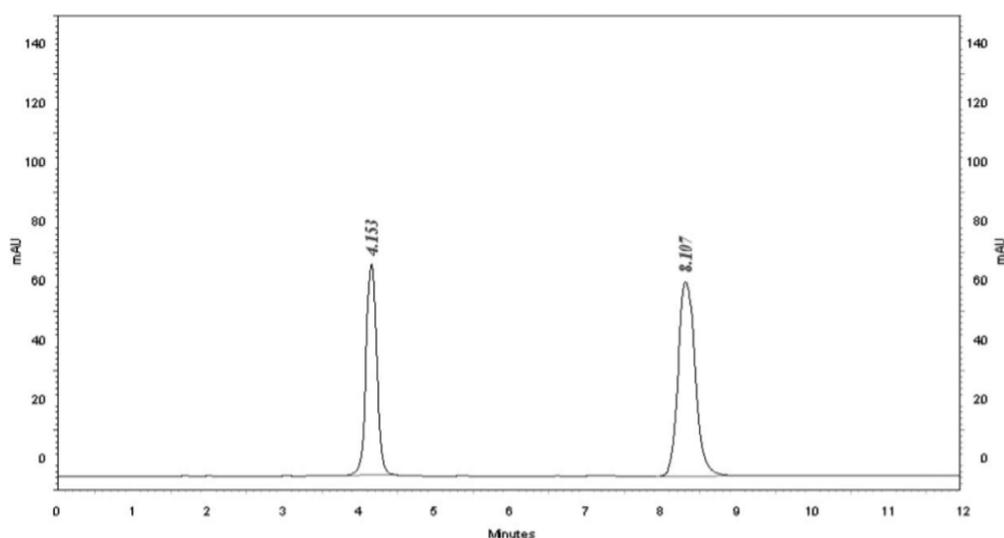


Fig. 1. Chromatogram of fenofibrate and atorvastatin

Table 7. Analysis of commercial formulation

Drug	Label Claim (mg/tab)	Amount Recovered*	Assay (%w/w)	%RSD
Atorvastatin	10	9.95	99.50	0.254
Fenofibrate	160	159.65	99.78	0.574

4. CONCLUSION

The developed method gave good resolution between atorvastatin and fenofibrate with short analysis time and high efficiency and complies with all system suitability test specifications of USP. The use of C18 column in the present work has indicated better elution of analytes with good resolution, improved plate count and capacity factor.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Jain N, Raghuwanshi R, Jain D. Development and Validation of RP-HPLC Method for Simultaneous Estimation of Atorvastatin Calcium and Fenofibrate in Tablet Dosage Forms. *Indian J Pharm Sci.* 2008;70(2):263-5. DOI: 10.4103/0250-474X.41473.
- Kadav AA, Vora DN. Stability indicating UPLC method for simultaneous determination of atorvastatin, fenofibrate and their degradation products in tablets, *Journal of Pharmaceutical and Biomedical Analysis.* 2008;48(1):120-126. ISSN0731-7085, Available: <https://doi.org/10.1016/j.jpba.2008.05.018>
- Krishna, Mudraboina & Sandhya, B & Huidrom, Sanayaima & Haque, M Akiful & Bakshi, Vasudha & Mudraboina, Johnny & Krishna,. Development and Validation of Standard Addition Uv Spectrophotometric Method For Simultaneous Estimation of Atorvastatin and Fenofibrate in Bulk and Pharmaceutical Dosage form. *IJIPSR.* 2014;2(11):2741-2748.
- Zaman MT, Khan SA, Arora A, Ahmad O. Method Development and Validation of Fenofibrate by Hplc Using Human Plasma, *Electron J Biomed.* 2009;3:41-54.
- Nakarani NV, Bhatt KK, Patel RD, Bhatt HS. Estimation of atorvastatin calcium and fenofibrate in tablets by derivative spectrophotometry and liquid

- chromatography. *J AOAC Int.* 2007;90(3): 700-5.
6. Said A. Hassan, Hany W. Darwish, Maissa Y. Salem, Development and Validation of HPoint Standard addition method applied for the analysis of binary mixture of Amlodipine and Atorvastatin, *International Journal of Pharma and bio Sci.* 2013;4(2):230-243.
 7. Ertürk S, Sevinç Aktaş E, Ersoy L, Fiçioğlu S. An HPLC method for the determination of atorvastatin and its impurities in bulk drug and tablets. *J Pharm Biomed Anal.* 2003;33(5):1017-23. DOI: 10.1016/s0731-7085(03)00408-4.
 8. Zaheer, Zahid, Farooqui, Mazahar, Mangle AA, Nikalje, Anna. Stability-indicating high performance liquid chromatographic determination of atorvastatin calcium in pharmaceutical dosage form. *African Journal of Pharmacy and Pharmacology.* 2008;2:204-210.
 9. Shah DA, Bhatt KK, Mehta RS, Baldania SL, Gandhi TR. Stability Indicating RP-HPLC Estimation of Atorvastatin Calcium and Amlodipine Besylate in Pharmaceutical Formulations. *Indian J Pharm Sci.* 2008;70(6):754-760. DOI:10.4103/0250-474X.49117
 10. Shah DA, Bhatt KK, Mehata RS, Baldania SL, Gandhi TR, Ind. *J Pharm Sci.* 2008;70(6):754. Shah DA, Bhatt K K, Mehata RS, Shankar MB, Baldania SL, Gandhi TR, Ind. *J Pharm Sci.* 2007;69(4): 701.
 11. Mishra P, Alka Gupta, Shah K. Simultaneous estimation of atorvastatin calcium and amlodipine besylate from tablets, *Indian J Pharm Sci,* 2007;69(6):831-833.
 12. Panchal HJ, Suhagia BN, Simultaneous determination of Atorvastatin calcium and Ramipril in capsule dosage forms by high performance liquid chromatography and high-performance thin layer chromatography. *J AOAC Int.* 2010;93(5): 1450-7.
 13. Potdar VH, Mule VS, Pishawikar SA, Jadhav SD, Thamake SL, RP-HPLC method for simultaneous estimation of atorvastatin calcium and ramipril from plasma, *Ars Pharmaceutica.* 2011;52(2):14-19.
 14. Panchal HJ, Suhagia BN, Patel NJ, Rathod IS, Patel BH. Simultaneous estimation of atorvastatin calcium, ramipril and aspirin in capsule dosage form by RPLC, *Chromatographia.* 2009;69(1-2):91-95.
 15. Mohammadi A, Rezanour N, Ansari Dogaheh M, Ghorbani Bidkorbeh F, Hashem M, Walker RB. A stability-indicating high performance liquid chromatographic (HPLC) assay for the simultaneous determination of atorvastatin and amlodipine in commercial tablets. *J Chromatogr B Analyt Technol Biomed Life Sci.* 2007;846(1-2):215-21. DOI: 10.1016/j.jchromb.2006.09.007. Epub 2006 Sep 28..
 16. Choudhari, Vishnu & Nikalje, Anna. Simultaneous Estimation of Atorvastatin, Ezetimibe and Fenofibrate in Pharmaceutical Formulation by RP-LC-PDA. *Pharmaceutical Analytica Acta.* 2010;1. DOI:10.4172/2153-2435.1000111. 10.4172/2153-2435.1000111.
 17. Sultana, Najma, Arayne, Mohammed & Naveed, Dr. Safila. Validated Method for the Simultaneous Determination of Lisinopril, Pravastatin, Atorvastatin and Rosuvastatin in API, Formulations and Human Serum by RP-HPLC. *Chinese Journal of Chemistry. Chinese Journal of Chemistry.* 2011;29:1216—1220. DOI/10.1002/cjoc.201190226
 18. Bhingde SD, Malipatil SM. A New Approach to the RP-HPLC Method for Simultaneous Estimation of Atorvastatin Calcium and Fenofibrate in Pharmaceutical Dosage Forms, *E-Journal of Chemistry.* 2012;9(3):1223-1229
 19. Nagaraj, Vipul K, Rajshree M. Simultaneous quantitative resolution of atorvastatin calcium and fenofibrate in pharmaceutical preparation by using derivative ratio spectrophotometry and chemometric calibrations. *Anal Sci.* 2007;23(4):445-51. DOI:10.2116/analsci.23.445. PMID: 17420550.
 20. Godge Ganesh Raosaheb, Garje Mahesh Arjun, Validated Spectrophotometric Method for Simultaneous Estimation of Fenofibrate and Atorvastatin in synthetic mixture and in bulk tablet dosage form, *World Journal of Pharmaceutical and Medical Research, WJPMR.* 2020;6(7): 170-176.
 21. Doménech-Carbó, Antonio, de Carvalho, Leandro M, Martini, Mariele and Cebrián-Torrejón, Gerardo. Voltammetric/

amperometric screening of compounds of pharmacological interest" Reviews in Analytical Chemistry. 2014;33(3):173-199. Available:<https://doi.org/10.1515/revac-2013-0027>

22. ICH, Topic Q2A, Validation of analytical procedures: methodology. PMP/ICH/281/95.

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