WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 7.523
Volume 6, Issue 4, 897-907. Research Article ISSN 2277– 7105

DEVELOPMENT AND VALIDATION OF RP HPLC METHOD FOR THE SIMULTANEOUS ESTIMATION OF ATENOLOL AND CHLORTHALIDONE IN TABLET FORMULATION

Hitesh C. Pimpale, Parag T. Bakshe*, Sachin S. Rane, Prof. (Dr.) Rajesh Y. Chaudhari, Prof. (Dr.) Vijay R. Patil

Department of Pharmaceutical Chemistry, T.V.E.S.'s Hon. L.M.C. College of Pharmacy, Faizpur- 425 503, Dist-Jalgoan, (M.S.), India.

Article Received on
27 Jan. 2017,

Revised on 19 Feb. 2017,
Accepted on 09 March. 2017

DOI: 10.20959/wjpr20174-8053

***Corresponding Author**
Parag T. Bakshe
Department of Pharmaceutical Chemistry, T.V.E.S.'s Hon.L.M.C. College of Pharmacy, Faizpur- 425 503, Dist-Jalgoan, (M.S.), India.

ABSTRACT

A new simple, rapid, precise and accurate assay method was developed for simultaneous estimation of Atenolol and Chlorthalidone in pure and tablet formulation. The analytes were separated by RP HPLC on a RP-Purosnosphere C18 column (5 µm, 4.6mm* 250 mm). The mobile phase was methanol: water (60:40 v/v) at 1.1 ml/min flow rate satisfactorily resolve the tertiary mixture. The UV detector was operated at 238 nm for the determination of all the drugs. Linearity, accuracy and precision were found to be acceptable over the concentration ranges of 10-160 µg/ml for Atenolol and 5-25 µg/ml for Chlorthalidone with a R^2 0.9957 and 0.9965values respectively. The optimized methods proved to be specific, robust and accurate for the quality control of drugs in bulk drug and pharmaceutical formulations.

KEYWORDS: Atenolol, Chlorthalidone, Method Validation, RP HPLC, ICH, C18.

INTRODUCTION

Drugs play a vital role in the progress of human civilization by curing diseases. Analytical chemistry is divided into two branches qualitative and quantitative.[1] Today a majority of the drugs used are of synthetic origin. These are produced in bulk and used for their therapeutic effects in pharmaceutical formulations. Pharmaceutical product quality is of vital importance for patient safety. Pharmaceutical analysis is the branch of pharmacy that is responsible for developing sensitive, reliable and accurate methods for the estimation of drugs in pharmaceutical dosage forms and biological fluids.[2]

Atenolol (ATN) is a β_1 receptor specific antagonist, chemically (RS)-4-(2-hydroxy-3-isopropylaminopropoxy) phenylacetamide[3] while Chlorthalidone (CTD) chemically described as a 2-Chloro-5-(1-hydroxy-3-oxo-2,3-dihydro-1H-isoindol-1-yl) benzenesulfonamide.[4] ATN with CTD is used in treatment of hypertension. Several methods are available in the literature for the determination of ATN and CTD most of these methods are for the determination of ATN and CTD separately, or in combination with other drug. Analytical methods reported for quantitative determination of ATN individually in pharmaceutical formulations or biological fluids are HPLC[5,6,7] and UV.[8,9,10] Analytical methods reported for quantitative determination of CTD individually in pharmaceutical formulations or biological fluids are HPLC[11,12,13,14], UV[15,16] and HPTLC.[17,18]

These drugs are used in combination therapy not only because blood pressure control is often inadequate using monotherapy but also because combination therapy can simplify dosing regimens, improve compliance, decrease side effects and reduce cost. Literature survey revealed that very few methods are reported for determination of ATN and CTD pharmaceutical formulations. Therefore it was thought worthwhile to develop simple, precise and robust analytical method for the same.

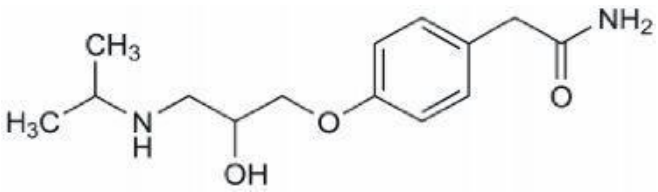

Fig. 1: Chemical structures of Atenolol

Atenolol

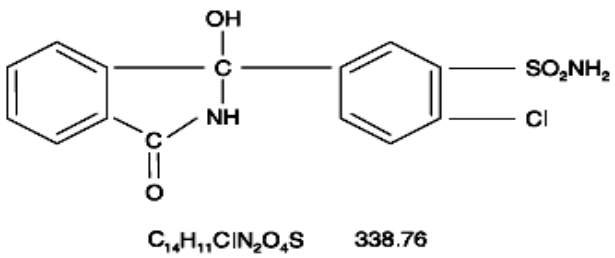

Fig. 2: Chemical structures of Chlorthalidone

Chlorthalidone

MATERIALS AND METHODS

EXPERIMENTAL

Chemicals and reagents

Atenolol was obtained as a generous gift samples from the Zydus Healthcare Pharmaceuticals Pvt. Ltd. (Sikkim) and chlorthalidone from Ipca laboratories ltd (Mumbai). Commercial pharmaceutical preparation TENORIC-25 tablets, containing Atenolol (ATN) 25 mg and Chlorthalidone 12.5mg was collected from local market. Acetonitrile, methanol and water used were of HPLC grade (Qualigens Fine Chemicals, Mumbai, India). Ammonium Acetate Buffer was AR grade (Qualigens Fine Chemicals, Mumbai, India). A 0.2 µm nylon filter (Pall life Sciences, Mumbai, India) was used. All other chemicals and reagents used were analytical grade unless otherwise indicated.

Apparatus

The chromatographic system (Systronics Corporation, India) consisted of LC 8600aprominence solvent delivery module, a manual injector with a 20 µL fixed loop and a UV-visible detector. The separation was performed on a Hibar® (Merk, Germany) RP-Purosphere Star C18 column (5 µm, 4.6mm* 250 mm) at an ambient temperature. Chromatographic data were recorded and processed using Chemitochrom 2000 software. A Fast clean ultrasonicate cleaner (India) was used for degassing the mobile phase. Shimadzu UV 1800 double beam UV visible spectrophotometer and Sansui-vibra DJ-150S-S electronic balance were used for Spectrophotometric and weighing purposes respectively.

Chromatography Conditions

Chromatographic separations of active (ATN and CTD) substances were obtained by using Hibar® (Merk, Germany) RP-Purosphere Star C18 column (5 µm, 4.6mm* 250 mm), mobile phase methanol : water (60:40 v/v) (PH 3.2 was adjusted with 10% Ammonium Acetate Buffer) was prepared, filtered through a 0.2 µm nylon filter and degassed for 5 min in an ultrasonicator. The mobile phase was pumped through the column at flow rate of 1.1 ml/min[1]. Analyses were carried out at ambient temperature with detection at 238 nm. The injection volume was 20 µL and each analysis required 12 min.

Standard Solutions

Stock standard solutions of ATN 1 mg/ml and CTD 1 mg/ml were prepared by dissolving 25 mg ATN standard and 12.5 mg CTD standard in 25 ml methanol. Working standard solutions of ATN 0.1 mg/ml and CTD 0.1 mg/ml were prepared by diluting suitable aliquots of

corresponding stock solutions with mobile phase.

Sample Solution

Twenty TENORIC-25 tablets containing ATN (25 mg) and CTD (12.5 mg) were weighed and ground to fine powder. A quantity of sample equivalent to ATN (25 mg) and CTD (12.5 mg) was transferred into 100 ml volumetric flask containing methanol (60 ml), sonicated for 15 min and the volume was made up to the mark and filtered through 0.45µm nylon membrane filter. This solution was (1 ml) transferred to 10 ml volumetric flaks, dissolved and volume was adjusted to the mark. The response of solution was measured at 238 nm and quantification of ATN and CTD was done by using present HPLC method. Typical chromatogram of final resultant formulation solution was shown in (Fig. 1).

Validation of Proposed Method

Calibration curve (linearity)

Accurately measured aliquots of working standard solutions equivalent to 20-120 µgm/ml ATN, and 5-30 µg/ml CTD were transferred to series of 10 ml volumetric flasks and the contents of the flasks were diluted to volume with mobile phase. A 20 µL aliquot of each solution was injected in triplicate into the liquid chromatography. The conditions including the flow rate of mobile phase at 1.1 ml/min, detection at 238 nm and run time program for 12 min, were adjusted. A calibration curve for each drug was obtained by plotting area under the peak versus concentration. The graphs of area vs concentration were recorded for all the drugs and are shown in (Fig. 3 and 4).

Accuracy (% recovery)

Recovery studies were carried out by adding a known amount of pure drugs ATN and CTD to a pre analyzed sample solution. These studies were carried out by spiking 80%, 100% and 120% respective drug. The recovery studies showed that the results were within acceptable limits, above 99% and below 101%. The results are given in (Table 2).

Method precision (repeatability)

The precision of the developed method was assessed in terms of repeatability, intraday and inter-day precision by analyzing six replicate standard samples. The % R.S.D. values of the results corresponding to the peak area and retention time were expressed for intra-day precision and on 3 days for inter-day precision.

Intermediate precision (reproducibility)

The intraday and interday precisions of the proposed method were determined by estimating the corresponding responses 5 times on the same day and on 5 different days for present method. The results are reported in terms of relative standard deviation (RSD).

Limit of detection (LOD) and limit of quantitation (LOQ)

LOD and LOQ of the drug were calculated using the equations according to International Conference on Harmonization (ICH) guidelines.

Robustness

Robustness of the method was determined by making slight changes in chromatographic conditions. Effect of % of methanol (59, 60 and 61%) in mobile phase on the retention time and slight changes in flow rate were applied as variable parameters. Flow rate varied at three levels (-1, 0, 1). One factor at the time was changed to estimate the effect. Thus standard solution at varied pH (pH 3.1, 3.2 and 3.3) three pH levels was performed.

Specificity

Specificity is the ability of the analytical method to measure analyzed response in presence of interferences including degradation products and related substances. Specificity was checked by determining ATN and CTD in laboratory prepared binary mixture and in binary mixture containing different degradation products.

System suitability Test

In the system suitability test tertiary solution of 25 µg/ml of ATN and 12.5 µg/ml of HCTZ (n=6) was prepared and injected. Then the system suitability parameters like retention time, theoretical plates, tailing factor and resolution were calculated from the chromatogram.

RESULTS AND DISCUSSION

The absorption spectra of ATN and CTD greatly overlap; so conventional determination of these compounds in mixture is not possible. To optimize the LC parameters, several mobile phase compositions were tried. A satisfactory separation and good peak symmetry for ATN and CTD were obtained with a mobile phase consisting of methanol: water (60:40 v/v), pH 3.2 adjusted using 10% Ammonium Acetate Buffer. Quantification of the drugs was performed at 238 nm. Resolution of the components with clear baseline separation was obtained.

Validation of the Proposed Method

Linearity

Linear correlation was obtained between peak areas and concentrations of ATN and CTD in range of 20–120 and 5–30 µg/ml, respectively. The linearity of calibration curves was found to be acceptable over the concentration ranges of 20-120 µg/ml for ATN while 5-30 µg/ml for CTD with a R^2 0.9926 and 0.9986 values respectively.

(Table- 1, Fig- 2 and 4). The results show that good correlation existed between the peak area and concentration of the analysts.

Accuracy

The recovery experiments were performed by the standard addition method. The recoveries obtained were 99.67and 99.86% for ATN and CTD respectively (Table 2). The high values indicate that the method was accurate.

Method precision

Precision study was carried out using parameter like method repeatability study which showed that results were within acceptable limit 0.572and 0.831 i.e. % RSD below 2.0 indicating that the method is reproducible. The results are shown in (Table No.2)

Intermediate precision

The intraday RSD values for ATN and CTD were 0.423-0.416 and 0.536-0.537%, respectively. The interday RSD values for ATN and CTD were 0.583–0.592 and 0.836–0.836%, respectively. The % RSD (< 2%) values indicate that the method was sufficiently precise (Table 2).

LOD and LOQ

LOD values for ATN and CTD found to be 3.48592µg/ml and 2.58491µg /ml, respectively. LOQ values for ATN and CTD were found to be 4.582048 µg/ml and 5.574839 µg/ml, respectively (Table 2). These data showed that the method was sensitive enough for the determination of ATN and CTD.

Robustness

The method was found to be robust with no significant changes on test result upon change of analytical conditions like different flow rate, % methanol in mobile phase and pH of mobile phase with the standard deviation was found to be bellow 1 and % RSD is less than 2 for all

results. It was found that under small deliberate changes of chromatographic factors, there was no considerable change in under study parameters.

System Suitability Test

A tertiary solution of 25 µg/ml of ATN and 12.5 µg/ml of CTD (n=5) was prepared and same was injected, then the system suitability parameters were calculated from the chromatogram. The parameters, retention times, resolution factor, tailing factor and theoretical plates were evaluated. The results (Table 4) obtained from system suitability tests are in agreement with the official requirements.

Table: 1 Regression analysis of the calibration curves for Atenolol and Chlorthalidonein the proposed HPLC Method

Parameter	Atenolol	Chlorthalidone
Linearity Range (µg/ml)	20-120	5-30
Detection Wavelength (nm)	238	
Slope ± SD	3.0729	28.733
Intercept ± SD	12.269	51.133
Correlation coefficient	0.9926	0.9986

(n= mean of three determinations)

Table 2: Summary of the validation parameters for the proposed HPLC method

Parameter	Atenolol	Chlorthalidone
LOD	3.48592µg /ml	2.58491µg /ml
LOQ	4.582048µg /ml	5.574839µg /ml
Accuracy,%	99.67 ± 0.65	99.86 ± 0.62
Repeatability (%RSD, n = 5)	0.572	0.831
Precision (RSD, %)		
Interday, n = 3	99.79 (0.592)	99.90 (0.836)
Intraday, n = 3	99.21 (0.416)	99.43 (0.537)

LOD = Limit of detection.

LOQ = Limit of quantification

RSD = Relative standard deviation.

Table 3: Assay results for the combined dosage form using the proposed HPLC method

Formulation	Atenolol	Chlorthalidone
TENORIC-25	99.98 ± 0.214	99.29 ± 0.4532

(n= mean of five determinations)

Table No. 4: System suitability test parameters for ATN and CTD for the proposed HPLC method

System Suitability Parameters	Proposed Method	
	ATN	CTD
Retention Time (t_R)	2.093	2.843
Capacity Factor (k)	0.35	0.42
Theoretical Plate Number (N)	6522	17674
Asymmetry factor	1. 941	1.983
Resolution Factor (R)	0	2.623

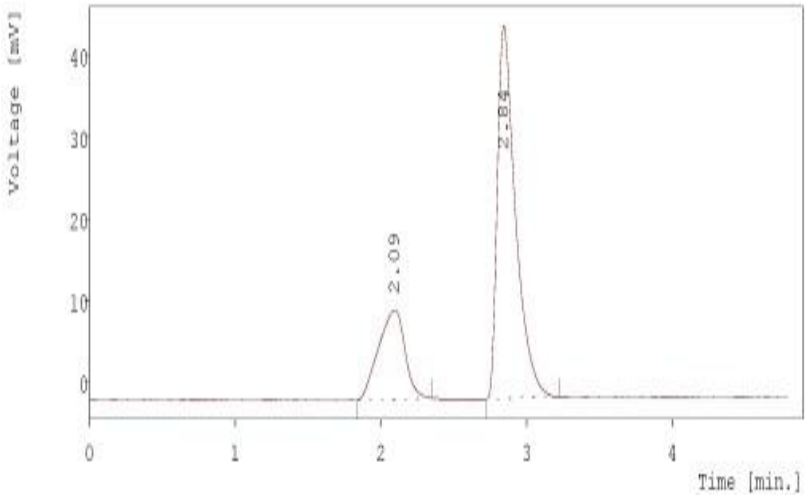

Fig. 3: Typical liquid chromatogram obtained for a 20 µL injection of a synthetic mixture of ATN and CTD

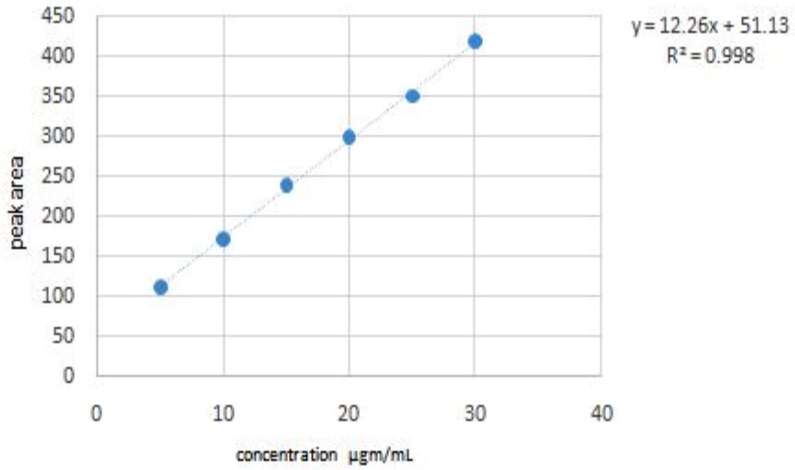

Fig. 4: Calibration Curve for Atenalol

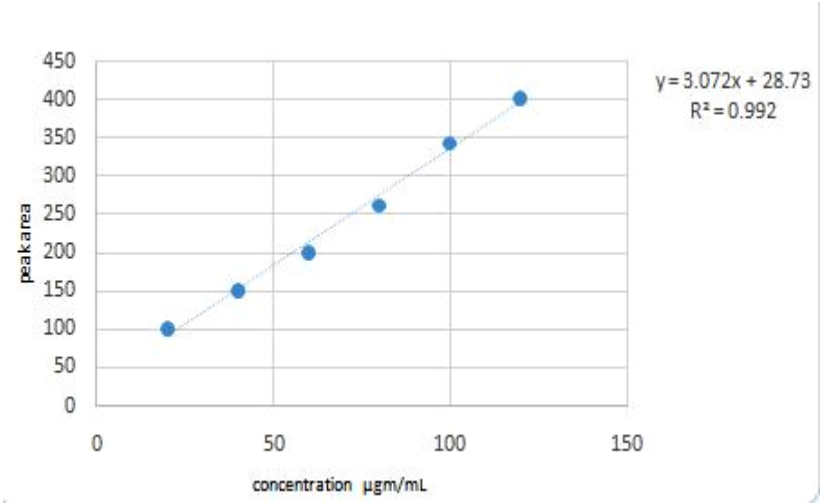

Fig. 5: Calibration Curve for Chlorthalidone

CONCLUSIONS

The proposed LC method presented in this paper has advantages of simplicity, accuracy, precision and convenience for separation and quantitation of ATN and CTD in combination and can be used for the assay of their respective dosage form. Moreover, the proposed LC method is a stability indicating assay method that can determine ATN and CTD in presence of their degradation products. Thus, the proposed LC method can be used for the quality control of ATN and CTD in typical laboratories.

ACKNOWLEDGEMENTS

The authors are thankful to Zydus Healthcare Pharmaceuticals Pvt. Ltd. and Ipca laboratories ltd for supplying generous gift samples of pure drugs. Hereby, the authors declare that there is no conflict of interests regarding the publication of this paper.

REFERENCES

1. G. H. Jeffery, J. Bassett, J. Mandham and R. C. Denny. Vogel's Text Book of Quantitative Chemical Analysis. 5th ed. U.K. Longman Scientific and Technical Pub, 1994; 3-4.
2. D. Watson: Pharmaceutical Analysis. 1st ed. Edinburgh: Churchill Livingstone, 1999; 1-11.
3. R. Gaur, M. Azizi, J. Gan, P. Hansal and K. Harper. British Pharmacopoeia. London: Medicines and Healthcare products Regulatory Agency (MHRA), 1988; 49: 903.
4. J. Martin, L. A. Claase, B. Jordan and C.R. Macfarlane. British National Formulary. London: BMJ Group & RPS Publishing; 27th ed, 2314-2316, (2009).

5. Bhusari V, Dhaneshwar S. Validated HPTLC Method for Simultaneous Estimation of Atenolol, Hydrochlorothiazide and Amlodipine Besylate in Bulk Drug and Formulation., International Journal of Analytical and Bioanalytical Chemistry, 2011; 1(3): 70-76.
6. Chheta N, Gandhi S, Rajput S. Development and Validation Of A Stabilityindicating High Performance Liquid Chromatographic (Hplc) Method for Atenolol and Hydrochlorthiazide In Bulk Drug And Tablet Formulation., International Journal of Chem Tech Research, July-Sept, 2009; 1(3): 654-662.
7. Krishna R, Gupta A, Wadodkar R, Wadodkar S. Validated Reverse Phase HPLC Method for Simultaneous Estimation of Atorvastatin and Atenolol in Tablets., Scholars Research Library Der Pharmacia Lettre, 2011; 3 (4): 393-403.
8. Jaina N, Jaina R, Thakura N, Jaina S, Jain D. Simultaneous Spectrophotometric Estimation of Lercanidipine Hydrochloride and Atenolol in Tablet Dosage Form., Eurasian J Anal Chem, 2011; 6(2): 84-90.
9. Lalitha G, Salomi P. Development of an Analytical Method and Its Validation for The Analysis of Atenolol In Tablet Dosage form by Uv- Spectrophotometry., Int J Pharm Pharm Sci, 2012; 5, 6(2): 197-199.
10. Dey S, Sarkar S, Malakar J, Ghosh A, Gangopadhyay A, Mazumder B. Spectrophotometric Method for Simultaneous Determination of Atenolol and Atorvastatin in tablet dosage forms, 2012; 3: 40-43.
11. Bapnal M, Bhoi K. Development and Validation of Analytical Method for Simultaneous Estimation of Cilnidipine and Chlorthalidone in their Combined Dosage Form., IntJ Ayu. Pharm Chem., 2015; 2(3): 306-308.
12. Devi L, et.al. A New Rp-Hplc Method Development and Validation for The Dissolution Studies of Atenolol and Chlorthalidone in Immediate Release Tablet Dosage Forms, 2014; 4(4): 958-96.
13. Charde M, Welankiwar A, Chakole R. Development of Validated Rp-Hplc Method for the Simultaneous Estimation of Atenolol and Chlorthalidone in Combine Tablet Dosage Form. 2014; 3(1): 241-243.
14. Ganipisetty L, Dachinamoorthy D, Seshagiri Rao J. Stability Indicating RP-HPLC-PDA Method for Simultaneous Estimation of Olmesartan Cilnidipine and Chlorthalidone with Forced Degradation Behavior Study in Bulk and in its Tablet Dosage Form Am.j. pharm Tech. Res., 2015; 5(2): 351-353.
15. Patel S, Patel D. Simultaneous Determination of Metoprolol Succinate and Chlorthalidone by UV Spectrophotometric Method, 2013; 1: 456-458.

16. Kavitha J, Muralidharan S. Development and Validation of New Method for Atenolol, Hydrochlorothiazide and Losartan Potassium by Rp-Hplc: its Application to Routine Quality Control Analysis, 2011; 2(2): 880-884.
17. Parmar K, Mehta R. Development and Validation of HPTLC Method for Simultaneous Determination of Telmisartan and Chlorthalidone in Bulk and Pharmaceutical Dosage Form, 2012; 3(2): 451-455.
18. Ingle S, Patil P, Kulkarni V, Patil S, Salunke P, Wagh R. Development and Validation of UV Spectrophotometric Method for Chlorthalidone in Bulk and Pharmaceutical Dosage Forms, 2010; 3(9): 958-963.