Innovare Academic Sciences

International Journal of Pharmacy and Pharmaceutical Sciences

ISSN- 0975-1491 Vol 6, Issue 10, 2014

Original Article

UV SPECTROPHOTOMETRIC METHOD DEVELOPMENT AND VALIDATION FOR THE QUANTITATIVE ESTIMATION OF SOLIFENACIN SUCCINATE IN TABLETS

B. RAKESH, P. BHARGAVI, S. RAKESH REDDY, A. ASHOK KUMAR*

Department of Pharmaceutical analysis and Quality Assurance, Vijaya college of pharmacy, Munaganur (village), Hayathnagar (mandal), Hyderabad 501511, India.
Email: ashok576@gmail.com

Received: 08 Jun 2014 Revised and Accepted: 01 Aug 2014

ABSTRACT

Objective: To develop a simple and cheap UV spectrophotometric method for the quantitative estimation of Solifenacin succinate (5mg) in tablets and validate as per ICH guidelines.

Methods: The optimized method uses a solvent 100% triethylammonium phosphate buffer (pH 2.5) for the estimation of assay of Solifenacin succinate in tablets at a detection wavelength of 215 nm.

Results: The developed method resulted in Solifenacin succinate exhibiting linearity in the range 5-15µg/ml. The precision is exemplified by relative standard deviation of 1.27%. Percentage Mean recovery was found to be in the range of 98-102, during accuracy studies. The limit of detection (LOD) and limit of quantitiation (LOQ) were found to be 1.106µg/ml and 3.35µg/ml respectively.

Conclusion: A simple and a cheap UV spectrophotometric method was developed and validated for the quantitative estimation of Solifenacin succinate in tablets as per ICH guidelines and hence it can be used for the routine analysis in various pharmaceutical industries.

Keywords: UV, Solifenacin succinate, Method development, Validation.

INTRODUCTION

Solifenacin succinate (Figure 1) is a competitive muscarinic acetylcholine receptor antagonist. Muscarinic receptor antagonists are widely used for treatment of the syndrome of overactive bladder and urge urinary incontinence [1-4]. The binding of acetylcholine to these receptors, particularly the M3 receptor subtype, plays a critical role in the contraction of smooth muscle. By preventing the binding of acetylcholine to these receptors, Solifenacin reduces smooth muscle tone in the bladder, allowing the bladder to retain larger volumes of urine and reducing the number of incontinence episodes. IUPAC name of Solifenacin succinate is Butanedioic acid, compound with (1S)-(3R)-1-azabicyclo [2.2.2] oct-3-yl 3,4-dihydro-1-phenyl-2(1H)-iso-quinolinecarboxylate (1:1), having an empirical formula of $C_{23}H_{26}N_2O_2$. $C_4H_6O_4$ and a molecular weight of 480.55. It is freely soluble at room temperature in water, Glacial acetic acid, dimethyl sulfoxide and methanol [1-4].

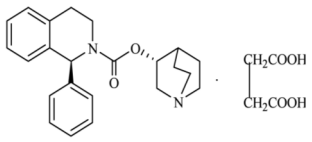

Fig. 1: Structure of Solifenacin succinate

Literature survey reveals chromatographic methods for the analysis of Solifenacin succinate in various pharmaceutical dosage forms [1-7]. Very few literature is cited on spectrophotometric methods [8-9]. Hence we here report a new, cheap, simple, accurate and precise UV method for the determination of assay of solifenacin succinate in SOLITEN tablets and validate the developed method as per ICH guidelines.

MATERIALS AND METHODS

Materials

Instrument

A double beam UV-visible spectrophotometer (Shimadzu, model 1800) having two matched quartz cells with 1 cm light path and loaded with UV probe software (version 2.41) was used for recording of spectra and measuring absorbance. An electronic analytical weighing balance (0.1mg sensitivity, Shimadzu AY 220), digital pH meter (DELUX model 101) and a sonicator (sonica, model 2200 MH) were used in this study.

Chemicals and Reagents

Analytically pure sample of Solifenacin succinate with purities greater than 99% was obtained as gift sample from RACHEM pharma, Hyderabad, India and tablet formulation [SOLITEN] was procured from MEDPLUS, Hyderabad, India with labelled amount 5mg of Solifenacin succinate. Triethylamine (AR Grade) and ortho phosphoric acid (AR Grade) were obtained from SD Fine chemicals (Hyderabad, India). 0.45µm Nylon membrane filters were obtained from Spincotech Private Limited, Hyderabad, India.

Method

Solvent

Solvent used is prepared by adding 5 ml of triethylamine to 1000 ml of distilled water and later pH was adjusted to 2.5 using 30% v/v of ortho phosphoric acid in water. Solvent was then filtered through 0.45 µm nylon membrane filter.

Selection of suitable detection wavelength

Suitable wavelength for the total experiment was determined by recording UV spectrum in the range of 200-400 nm for Solifenacin succinate and suitable wavelength selected was 215 nm (Figure 2).

Preparation of working standard solution

10mg of Solifenacin succinate was accurately weighed and taken in 100 ml clean and dry volumetric flask containing 80 ml of solvent and then the solution was made up to the mark using the solvent. This is considered as standard solution (10µg/ml), treated as working standard, 100% target concentration.

Preparation of stock and working sample solution

Ten tablets were weighed separately and the average weight wqas determined. The average weight was weighed from the ten tablets

grinded in a pestle and mortar, transferred to a 100 ml volumetric flask containing 100 ml diluent and then sonicated for 3 minutes, followed by filtration through 0.45µ nylon membrane filter to get sample stock solution of 50µg/ml. 2 ml of the above stock solution was pipetted out and made up to 10 ml to get working sample solution equivalent to a concentration of working standard of 10 µg/ml.

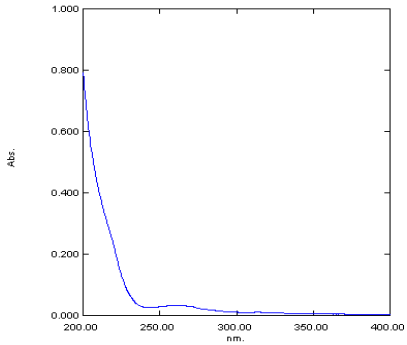

Fig. 2: UV spectrum of Solifenacin succinate

RESULTS AND DISCUSSION

Method Development

Various solvents were explored, including Potassium dihydrogen orthophosphate, triethylammonium phosphate and ammonium acetate buffers varying pH in the ranges of 2-7. Solifenacin succinate was found to be soluble and stable for minimum of 1 hour at room temperature using pH 2.5 triethylammonium phosphate buffer and hence this buffer was initiated for the determination of suitable detection wavelength and working concentration of standard. In order to test the applicability of the developed method to a commercial formulation, SOLITEN was studied at working concentration. Absorbance and assay for working concentration of sample at 215 nm was in acceptance limits (98-102%) with the standard working concentration during extraction of drug in the sample using the solvent for 3 minutes. The protocol affords reproducible quantification of the drug in the sample ranging between 98 and 102%, which is the standard level in any pharmaceutical quality control. Hence the method is optimized.

Method validation

Validation of the analytical method is the process that establishes by laboratory studies in which the performance characteristics of the method meet the requirements for the intended analytical application. UV spectrophotometric method developed was validated according to International Conference on Harmonization (ICH) guidelines [10] for validation of analytical procedures. The method was validated for the parameters like linearity, accuracy, system precision, intra-day precision, inter-day precision/ intermediate precision/ ruggedness, robustness, limit of detection (LOD) and limit of quantitiation (LOQ).

Precision

System precision

Six replicate recording of absorbance at 215 nm of standard solution at working concentration showed % RSD (Relative Standard Deviation) less than 2 concerning absorbance for the drug, which indicates the acceptable reproducibility and thereby the precision of the system. System precision results are tabulated in table 1.

Method precision

Method precision was determined by performing assay of sample under the tests of repeatability (Intraday precision) at working concentration.

Table 1: System precision results of Solifenacin succinate.

n	Absorbance
1	0.322
2	0.321
3	0.322
4	0.320
5	0.324
Average	**0.321**
SD	**0.0014**
% RSD	**0.43**

Table 2: Intraday precision results of Solifenacin succinate

n	% Assay
1	99.61
2	98.07
3	99
4	101.45
5	100.22
Average	**99.67**
S. D.	**1.273**
% RSD	**1.277**

Table 3: Calibration data for Solifenacin succinate

% Level	Concentration (µg/ml)	Absorbance 1	Absorbance 2	Absorbance 3
50	5	0.141	0.136	0.147
75	7.5	0.233	0.228	0.240
100	10	0.322	0.307	0.315
125	12.5	0.393	0.378	0.386
150	15	0.481	0.483	0.464
Regression equation		y=0.033x-0.022	y=0.033x-0.031	y=0.031x-0.009
Regression coefficient		0.998	0.996	0.997

Table 4: Results of Accuracy studies for Solifenacin succinate

Concentration level (%)	*%Mean recovery
50	98.38
100	101.45
150	99.20

*Mean of three replicates

Table 5: Robustness results of Solifenacin succinate sample

Variation parameter	Variation	% Assay
pH(± 0.2)	2.3	98.44
	2.5	99.67
	2.7	101.03
Wave length	213	98.72
(± 2 nm)		
	215	99.67
	217	99.34

Repeatability (Intraday precision)

Six consecutive recording of absorbance at 215 nm of the sample from the same homogeneous mixture at working concentration showed % RSD less than 2 concerning % assay for the drug which indicate that the method developed is method precise by the test of repeatability and hence can be understood that the method gives consistently reproducible results (Table 2).

Linearity

Standard solutions of Solifenacin succinate at different concentrations level (50%, 75%, 100%, 125% and 150%) were prepared. Calibration curve was constructed by plotting the concentration level of drug versus corresponding absorbance at 215 nm. The results show an excellent correlation between absorbance and concentration level of drug within the concentration range (5-15µg/ml) for the drug and the results are given in table 3**.** The correlation coefficients were greater than 0.995, which meet the method validation acceptance criteria and hence the method is said to be linear in the range of 5-15µg/ml.

Accuracy

Accuracy was determined by means of recovery experiments, by the determination of % mean recovery of sample at three different levels (50-150%). At each level, three determinations were performed. Percent mean recovery was calculated as shown in table 4. The accepted limits of recovery are 98% - 102% and all observed data are within the required range which indicates good recovery values and hence the accuracy of the method developed.

Robustness

The robustness of an analytical method is a measure of its capacity to remain unaffected by small but deliberate variations in method parameters and provides an indication of its reliability during normal usage. It is concluded that the method is robust as it is found that the % RSD is less than 2 for the drug concerning % assay despite deliberate variations done concerning pH ± 0.2 and detection wavelength ± 2 nm (Table 5).

Sensitivity

The sensitivity of measurement of Solifenacin succinate by use of the proposed method was estimated in terms of the limit of quantitation (LOQ), limit of detection (LOD) and Sandell's sensitivity. The limit of detection (LOD) and limit of quantitiation (LOQ) were found to be 1.106µg/ml and 3.35µg/ml respectively. Optical characteristics and validation parameters results are summarized in table 6.

Table 6: Optical characteristics and validation parameters of Solifenacin succinate

Parameters	Results
Detection wavelength (nm)	215
Beer's Law limits (µg/ml)	5-15
Sandell's sensitivity (µg/cm^2/0.001 absorbance unit)	0.05
Regression equation (y = mx+c)	y=0.0328x-0.020
Correlation coefficient (r^2)	0.997
Slope (m)	0.0328
Intercept (c)	-0.020
% Relative Standard Deviation (% RSD) System precision	0.43
(% RSD) Intra-day precision	1.27
(% RSD) Inter-day precision	
Accuracy (% Mean Recovery)	
50 % Level	98.38
100 % Level	101.45
150 % Level	99.20
LOD (µg/ml)	1.106
LOQ (µg/ml)	3.35
Robustness	
pH(± 0.2) (% RSD)	≤ 2
Wavelength (± 2 nm) (% RSD)	≤ 2

CONCLUSION

A cheap and a rapid UV spectrophotometric method was developed and validated for the quantitative estimation of Solifenacin succinate in tablets as per ICH guidelines. The developed method resulted in Solifenacin succinate exhibiting linearity in the range 5-15 µg/ml. The precision is exemplified by relative standard deviation of 1.27%. Percentage Mean recovery was found to be in the range of 98-102,

during accuracy studies. The limit of detection (LOD) and limit of quantitiation (LOQ) were found to be 1.106µg/ml and 3.35 µg/ml respectively. Accordingly it is concluded that the developed UV spectrophotometric method is accurate, precise, linear and robust and therefore the method can be used for the routine analysis of Solifenacin succinate in tablets in various pharmaceutical industries.

ACKNOWLEDGEMENT

The authors would like to thank the management of Vijaya college of pharmacy (VJYH), Hyderabad, for providing the necessary facilities to carry out of this research work. The authors are grateful to RACHEM pharma, Hyderabad for providing drug in form of gift sample.

REFERENCES

1. Rami Reddy BV, Srinivasa Reddy B, Raman NVVSS, Subhash Reddy K, Rambabu C. Development and validation of a specific stability indicating High Performance Liquid Chromatographic methods for related compounds and assay of Solifenacin Succinate. J Chem 2013;1-10.
2. Desai D, Patel G, Shukla N, Rajput S. Development and validation of stability-indicating hplc method for solifenacin succinate: isolation and identification of major base degradation product. Acta Chromatographica 2012;24(3):399–418.
3. Annapurna MM, Sowjanya G, Santosh Naidu M, Lohithasu D. A Validated Liquid Chromatographic method for the determination of Solifenacin Succinate (UrinaryAntispasmodic) in tablets. Chem Sci Transactions 2014;3(2):602-7.
4. Saroj Kumar R, Ravi kumar BVV, Ajaya Kumar P. A RP-HPLC method development and validation for the estimation of solifenacin in bulk and pharmaceutical dosage forms. Int J Bioassays 2012;01(12):210-3.
5. Radha Krishna S, Rao BM, Someswara Rao N. A Validated Rapid Stability-Indicating method for the determination of related substances in Solifenacin Succinate by Ultra-Fast Liquid Chromatography. J Chromatographic Sci 2010;48:807-10.
6. Vijayasree AV, Anantha kumar AD, Seshagiri rao BJVLN. Validated RP-HPLC method for the estimation of solifenacin succinate in tablet dosage forms. Pharmanest 2013;4(2):206-12.
7. Nilesh D, Hussen SS, Vasanthraju SG, Karthik A, Udupa N. Development & validation of stability indicating HPLC method for determination of solifenacin in bulk formulations. Int J Pharm Pharm Sci 2011;3(1):70-4.
8. Divya teja G, Deva dasu CH, Srinivasa babu P, Ravi sankar P. Quantitative analysis of solifenacin succinate in pharmaceutical dosage form using uv absorption spectroscopy. J Chem Pharm Sci ; 6(3):195-8.
9. Seetharaman R, Lakshmi KS. Development and validation of first order derivative spectrophotometric method for estimation of Solifenacin Succinate in pharmaceutical formulation. Int J Res Pharm Biomed Sci 2011;2(3):1052-7.
10. International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human use. Validation of Analytical Procedures: Text and Methodology ICH Q2 (R1); 2005.