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Method development and validation of solifenacin succinate in pharmaceutical dosage form using first order derivative UV spectrophotometry

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Abstract

A new simple, accurate and precise first order derivative assay method was developed and validated for the quantitative determination of solifenacin succinate in bulk and tablets dosage form using UV-visible spectrophotometer. In this method, water was used as solvent, with the absorption maxima of 294 nm. The developed method obeyed Beer's law in the concentration range of 100-500 µg/ml with correlation coefficient of 0.999. The method showed good reproducibility and precision in this concentration range. The % recovery and % RSD values were found to be within the limits, indicating the method to be accurate and precise, respectively. The LOD and LOQ values were found to be 6.4 µg/ml and 19.4 µg/ml. The validation parameters tested in accordance with the requirements of ICH guidelines, prove the suitability of this method. The proposed method can be used for routine quality control analysis for the estimation of solifenacin succinate in bulk and tablet dosage form.

1. Introduction

Solifenacin succinate is chemically designated as (3R)-1-azabicyclo [2.2.2] octan-3-yl] (1*S*)-1-phenyl-3,4-dihydro-1H-isoquinoline-2-carboxylate; butanedioic acid. It has a molecular formula $C_{27}H_{32}N_2O_6$ and molecular weight 480.6 g/mol (BNF, 2018). It is a white-to-pale-yellowish-white crystal or crystalline powder, freely soluble in water, methanol and dimethyl sulfoxide (Merck Index, 2006). Solifenacin succinate is used to treat overactive bladder and neurogenic detrusor overactivity. It may help with incontinence, urinary frequency and urinary urgency. (Kobayashi *et al.*, 2001; WHO, 2017). Literature survey reveals that there were few analytical methods developed for the estimation of solifenacin succinate in pharmaceutical dosage form such as UV spectrophotometer (Rakesh *et al.*, 2014; Singh and Nanda, 2011), HPLC (Tanuja *et al.*, 2021; Bhavana *et al.*, 2019; Chandra Mohan *et al.*, 2014; Reddy *et al.*, 2017), but no first order derivative UV spectrophotometric method was developed for the determination of solifenacin succinate in pharmaceutical dosage forms. The present study aimed to develop and validate a first order derivative UV spectrophotometric method for the determination of solifenacin succinate in pharmaceutical dosage form (Figure 1).

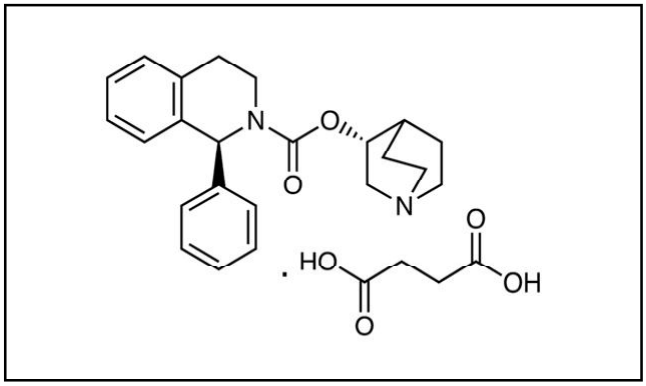

Figure 1: Chemical structure of solifenacin succinate.

2. Materials and Methods

2.1 Chemical and reagents

The solifenacin succinate working standard was procured from Vishnu Institute of Pharmaceutical Education and Research, Medak, Telangana. The tablet dosage form (solifenac) was purchased from local pharmacy. All the solvents and reagents used for the development of method were of AR grade and purchased from Merck, Mumbai, India.

2.2 Instrumentation

T60 UV-visible spectrophotometer with 1cm matched quartz cuvettes was used for the estimation of solifenacin succinate in pharmaceutical dosage form. The parameters were controlled by UV win software. Other instruments used for the method was electronic balance of Aczet make.

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2.3 Experimental work

2.3.1 Solubility studies

Different solvents such as ethanol, methanol, chloroform, acetonitrile, 0.5 N sodium hydroxide solution were used for the solubility studies.

2.3.2 Selection of suitable solvent

One of the above solvents will be selected based on the solubility studies.

2.3.3 Selection of detection wavelength

The standard solution of 10 µg/ml was prepared and scanned in the wavelength range of 200-400 nm.

2.3.4 Preparation of standard and sample solution

Accurately weighed and transferred an amount of 100 mg of solifenacin succinate working standard into 100 ml of clean volumetric flask. 70 ml of the distilled water was added to dissolve the drug. The volume was made upto the mark using distilled water. The 3 ml of the above solution was diluted to 10 ml with distilled water.

Average weight of 20 tablets of solifenacwas calculated and an amount equivalent to 100 mg was weighed and transferred into 100 ml of clean volumetric flask. 70 ml of the distilled water was added to dissolve the solifenacin succinate. Finally, make up the volume to 100 ml with distilled water. The solution was filtered and 3 ml of the solution was diluted to 10 ml with distilled water.

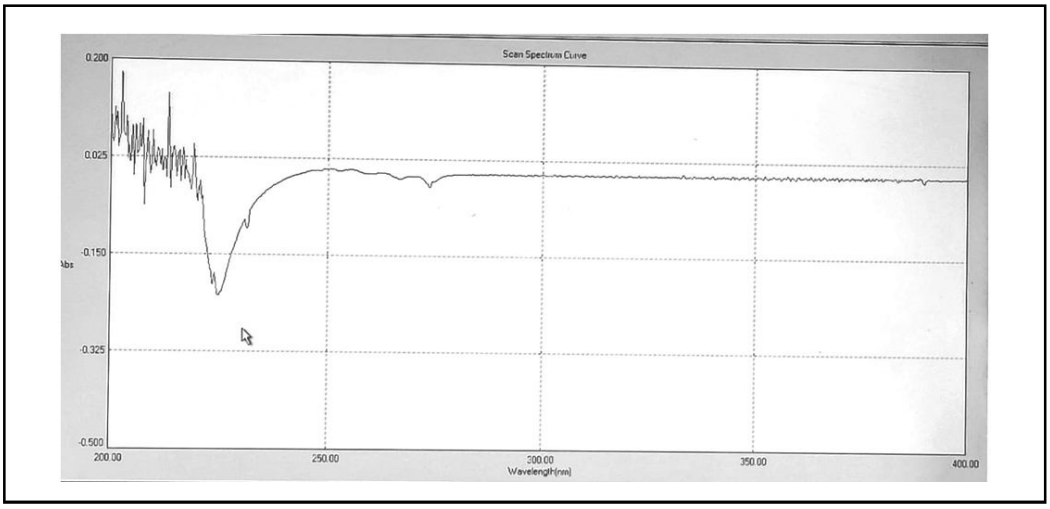

Figure 2: First order derivative UV spectrum of solifenacin succinate.

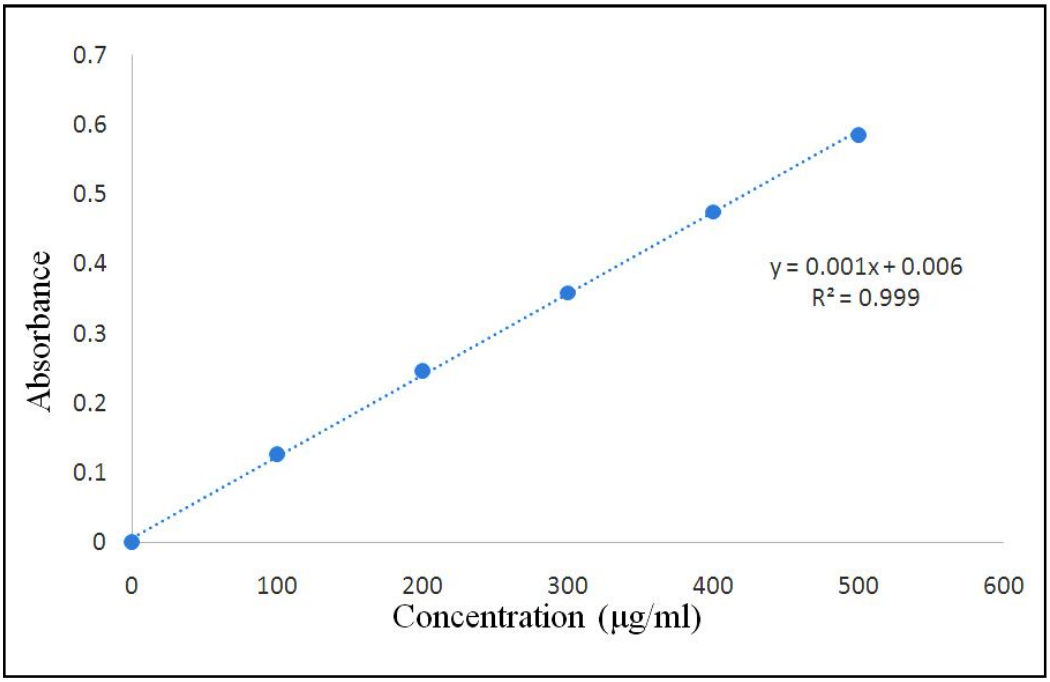

Figure 3: Linearity plot of solifenacin succinate.

2.3.5 Method validation

ICH, 2005; ICH, 2003; ICH, 1996; Jahnavi Bandla *et al.*, 2021.

2.3.5.1 Linearity

Serial dilutions of standard solifenacin succinate in the range of 100 µg/ml and 500 µg/ml were prepared and placed in the system. A linearity graph was plotted between concentration and absorbance.

2.3.5.2 Accuracy

The solutions were prepared in three different concentration levels of 50%, 100% and 150%, placed in the system and % recoveries were calculated.

2.3.5.3 Precision

The precision of the method was determined by intra and inter-day precision studies. The standard solution was placed six times on the same day (intra-day) as well as on different day (inter-day) and the % RSD was calculated.

2.3.5.4 Specificity

The specificity of the method was determined by placing the placebo solution and comparing with standard solution for the interference with solifenacin succinate peak.

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

LOD and LOQ are determined by standard deviation (SD) and slope of the calibration curve. The limiting values are calculated as per the following equations: LOD = (3.3 × SD)/Slope and LOQ = (10 × SD)/ Slope.

3. Results

The first order derivative UV spectrum was shown in Figure 2.

The optical characteristics values were calculated and results were presented in Table 1.

Table 1: Optical characteristics

S.No.	Parameters	Results
1	Absorption maximum	294 nm
2	Linearity range	100-500 µg/ml
3	Regression equation	y =0.0012x + 0.0069
4	Slope	0.0012
5	Intercept	0.0069
6	Correlation coefficient (r)	0.9997
7	Molar extinction coefficient ($l.mol^{-1}$ cm^{-1})	610.2
8	Sandell's sensitivity (µg/cm^2 - 0.001 absorbance units)	0.7874
9	Accuracy (% recovery)	98.5%-101.48%
10	Precision (intra-day) %RSD (inter-day) %RSD	0.390.15
11	LOD	6.4 µg/ml
12	LOQ	19.42 µg/ml
13	Standard error	0.002331

The linearity results were summarised in Table 2 and linearity plot was shown in Figure 3.

Table 2: Linearity results

S.No.	Concentration (µg/ml)	Absorbance
1	100	0.127
2	200	0.246
3	300	0.359
4	400	0.475
5	500	0.586
Regression coefficient (r^2)		0.9995
Correlation coefficient (r)		0.9997

4. Discussion

Initially, the method was developed for the estimation of solifenacin succinate in tablet dosage form by dissolving in different solvents such as ethanol, methanol, water, acetonitrile and 0.5 N sodium hydroxide solution. The drug was found soluble in based on the solubility studies and methanol was selected as the suitable solvent for the development of method. The solution has an absorption maxima at 294 nm when scanned in the wavelength range of 200-400 nm.

The standard solution and sample solution of solifenacin succinate was prepared as mentioned above and placed in the spectrophotometer for the measurement of absorbance. The optical characteristics such as absorption maxima, Beer's law limits, molar absorptivity, sandell's sensitivity, slope (b), intercept (c), correlation coefficient (r) obtained from different concentrations, and percent relative standard deviation values were calculated.

The developed method was validated as per the ICH guidelines. The method obeyed Beer's law in the concentration range of 100-500 µg/ml, with correlation coefficient of 0.999, indicating the method to be linear.

The % recovery for solifenacin succinate was found to be 98.57%-101.48%, indicating the method to be accurate. For the determination of precision, the % relative standard deviation (RSD) was calculated for inter-day precision and intra-day precision. The % RSD for inter-day precision was found to be 0.15 and for intra-day precision, it was found to be 0.39, indicating the method to be precise.

The method was found to be specific when compared with the blank solution, as there was no interference of blank with the solifenacin succinate peak in the spectrum. The LOD was found to be 6.4 µg/ml and LOQ was found to be 19.4 µg/ml.

5. Conclusion

A new accurate, precise and specific first order derivative UV spectrophotometric method was developed for the quantitative estimation of solifenacin succinate in pure drug and tablet dosage form. The method was established according to ICH guideline and definition. Accuracy was investigated by analyzing marketed formulations and percentage recovery was found to be within the limits. Therefore, it can be said that the method were highly accurate. The inter-day and intraday relative standard deviation values with low percentage RSD values were obtained. This indicated that the precision of the method was found to be good. The method was validated with respect to linearity, precision, accuracy and sensitivity.

The proposed method based on spectrophotometer is precise, accurate, simple to perform and economy in practice. It does not require expensive or sophisticated and chemicals in contrast with chromatographic method. Hence, the method can easily and conveniently adopt for the estimation of solifenacin for bulk and pharmaceutical dosage form. This spectrophotometric method developed can be used for the quality control and routine analysis of solifenacin succinate in pharmaceutical formulations.

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Conflict of interest

The authors declare no conflicts of interest relevant to this article.

References

British National Formulary (2018). BNF **76** (76 ed.). Pharmaceutical Press, pp:761.

ICH Harmonized Triplicate Guideline (2005). Validation of analytical procedures: Text and Methodology, Q2 (R1).

ICH Harmonized Triplicate Guideline (2003). Stability testing of new drug substances and products, Q1A (R2). International Conference on Harmonization, pp:1-18.

International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human use (1996). ICH harmonized tripartite guideline. In: Stability testing: photostability testing of new drug substances and products, Q1B.

Jahnavi Bandla; Nameera Jabeen and Ashok Gorja. (2021). Development and validation of first order derivative UV spectrophotometric method for the determination of fluvastatin sodium in formulation. International Journal of Pharmaceutical Sciences and Research, **12**(12):6721-24.

Kobayashi, S.; Ikeda, K.; Suzuki, M.; Yamada, T. and Miyata, K. (2001). Effects of YM905, a novel muscarinic M3-receptor antagonist on experimental models of bowel dysfunction *in vivo*. Japanese Journal of Pharmacology, **86**(3):281-288.

Rakesh, B.; Bhargavi, P.; Reddy, S.R. and Kumar A.A. (2014). UV-Spectrophotometric method development and validation for the quantitative estimation of solifenacin succinate in tablets. International Journal of Pharmacy and Pharmaceutical Sciences, **6**:190-193.

Singh, L. and Nanda, S. (2011). Spectrophotometric estimation of solifenacin succinate in tablet formulations. Pharmaceutical Methods, **2**(1): 21-24.

The Merck Index (2006). An Encyclopaedia of Chemicals, Drugs and Biologicals (14 ed.), pp:1494.

World Health Organization (2017). International Nonproprietary names for pharmaceutical substances (INN). Recommended International Nonproprietary Names: List 47 (PDF), pp:106.

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