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Research Article

Development of Simple, Precise UV Spectroscopic Method for the Estimation of Escitalopram Oxalate in Bulk and Marketed Tablets

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A B S T R A C T

Two new simple and accurate solvent mediums have been presented for the quantification of Escitalopram Oxalate (ESC) in tablet dosage form. A linear relationship found in the concentration range of 1-24 µg/ml for two proposed mediums viz., phosphate buffer pH 7.4 (Medium 1) and methanol: phosphate buffer pH 7.4 [1:1](Medium 2).The goodness of fit study suggests good correlation coefficient (R^2 - 0.9998 and 0.9998 for proposed mediums) shows the validity of Beer's law with intercept response < 2% calculated by the least square method indicating functional linearity between the concentration of analyte and the absorbance. Based on standard deviation of the response and slope, the LOD values for ESC for the proposed mediums found to be 0.348±0.00238 µg/ml, 0.273±0.0014 µg/ml and LOQ values found to be 1.046±0.002458 µg/ml, 0.823±0.00065 µg/ml with % RSD values less than 2.The proposed methods were successfully applied to the determination of commercially available tablets with a high percentage of recovery, good accuracy and precision.

Keywords: Escitalopram Oxalate, UV spectroscopy, Validation, Accuracy, Precision

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INTRODUCTION

Escitalopram oxalate (ESC) is a selective serotonin reuptake inhibitor (SSRI) and are widely known for their use in the treatment of depression, anxiety, and other related disorders[1, 2, 3]. Chemically Escitalopram oxalate is (1*S*)-1-(3-(dimethyl amino) propyl)-1-(4-fluorophenyl)-3*H*-2-benzofuran-5-carbonitrile, oxalic acid (figure 1). Literature reported few analytical methods for the quantification of ESC alone and combination in pharmaceutical preparations viz., ultraviolet spectrophotometric (UV)[4-9] and reverse phase-high-performance liquid chromatography (RP-HPLC)[10-19] and high-performance thin layer chromatography[20-22]. The reported methods found to be tedious and expensive so there is a need for a simple, rapid, cost effective and reproducible method for quantification. Therefore, it was thought of interest to develop simple, accurate, fast and cost-effective method for the quantification of ESC in tablet dosage form.

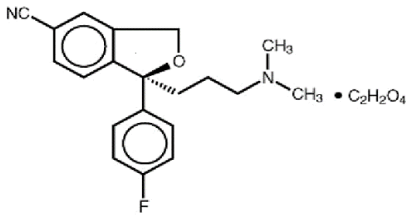

Figure 1: Chemical structure of Escitalopram Oxalate

MATERIALS

Escitalopram oxalate (ESC) obtained as gift sample Magnus Pharma Ltd, Birgunj, Nepal. Nescital 10 mg (Alkems Drugs and Pharmaceuticals Ltd., Uttrakhand, India) and ESC IP 10 mg (Bharatiya Jan Aushadhi Kendra, India) procured from community pharmacy. All reagents, solvents used were of

analytical grade (SD Fine-Chemicals, Bangalore, India. UV–visible Spectrophotometer (SHIMADZU, Japan Model, UV-1900 Pharma Spec).

METHODS

Two solvent mediums viz., phosphate buffer pH 7.4 (Medium 1) and Methanol: Phosphate buffer pH 7.4 [1:1] (Medium 2) were chosen for the quantification of ESC in tablet dosage form.

Preparation of ESC standard stock solution: Transfer accurately weighed 25 mg of ESC into a 25 ml volumetric flask to this add 20 ml of Medium 1shake for 5 min and sonicate for 5 min to dissolve completely, then make the volume to 25 ml to obtain 1mg/ml concentration. Similarly prepare ESC standard stock solution in Medium 2.

Preparation of ESC working standard solution: In each standard stock solution, pipette out 2.5 ml into a two different 25 ml volumetric flask, make up the volume with both the Medium 1 and Medium 2 respectively to obtain 0.1mg/ml concentration.

Sample preparation for tablets (Nescital 10 mg; ESC IP 10)

In each case of marketed tablets, ten tablets were accurately weighed and powdered to a fine powder. A quantity of powder equivalent to 50 mg ESC was weighed and transferred into two different 100 ml volumetric flasks. Extract the ESC in Medium1andMedium 2 byshaking for 1hr and sonicate for 30 min and final volume was made up to the mark with respective mediums. Filter the solutions and dilute appropriately with Medium 1 and Medium 2 in series of 10 ml volumetric flasks for further studies.

Method development

Determination of absorption maxima (λ max): Appropriately dilute two working standard solution with Medium 1 and Medium 2 solution separately in 10 ml volumetric flask to get 10 µg/ml solution, scan these solutions in the range of 200 to 400 nm using double beam UV spectrophotometer, and observe the characteristic peak at standard wavelength (nm).

Range: The linearity is the ability of analytical procedure to produce test results, which are proportional to the concentration (amount) of analyte in samples within a given concentration range. Appropriately dilute ESC working standard with Medium 1 and Medium 2 in a series of 10 ml volumetric flask to obtain 1, 2, 3, 4, 5, 6, 8, 10, 12,15,18, 20, 24, 28, 30, 35, 40 and 50 µg/ml concentrations and measure the absorbance. These studies are done in triplicates.

Linearity: Appropriately dilute Medium 1 and Medium 2 ESC working standard solutions in a series of 10 ml volumetric flask to obtain 2,4,6,8 and 10 µg/ml concentrations and measure the absorbance to construct calibration curve by plotting concentration vs absorbance.

Limit of detection (LOD) and Limit of quantification (LOQ): Appropriately dilute Medium 1 and Medium 2 ESC working standard solutions in a series of 10 ml volumetric flaskto determine LOD and LOQ. Both are determined based on standard deviation (SD) of response and slope (S) by using the following equations.

(LoD = 3.3 x SD/S); (LoQ = 10 x SD/S)

Validation

Precision: Precision in terms of reproducibility and interday and intraday reproducibility of proposed mediumswere carried out at different concentrations prepared by diluting appropriately Medium 1 and Medium 2 ESC working standard solutions and express the results in terms of % RSD.

Robustness:A robustness study performs to check the influence of method parameters varied intentionally on the proposed method results.Appropriately dilute Medium 1 and Medium 2 ESC working standard solutions in a series of 10 ml volumetric flask. Measure the absorbance at change in the experimental parameter viz., varied wavelength ± 5 nm and interpret the results in terms of % RSD.

Ruggedness:A ruggedness study performs to check the influence of process parameters varied intentionally on the proposed method viz., different analyst and different UV instrument.Appropriately dilute Medium 1 and Medium 2 ESC working standard solutions in a series of 10 ml volumetric flask, measure the absorbance by two analyst and two different instruments and interpret the results in terms of % RSD.

Accuracy: The most common technique for determining accuracy in analytical method development studies is the recovery method, recovery defined as the ratio of the observed result to the expected result expressed as a percentage. Appropriately dilute the marketed sample preparations in Medium 1 and Medium 2 separately, measure the absorbance and assayed as percent of ESC recovered. Standard addition method applied for recovery studied, in which a sample assayed with known amount of ESC (40%, 60% and 80%) added to the prequantified test samples and assayed as percent recovered.

Solution stability:The stability of stock solutions of ESC in Medium 1 and Medium 2 studied at different temperature (45°C) and refrigerated temperature (2-8°C). The samples were stored in tightly sealed glass containers protected from light for 24 hr and 48 hr. After storage period dilute appropriately Medium 1 and medium 2 standard stock solutions in a series of 10ml volumetric flask and the absorbance and interpret the results in terms of % RSD.

RESULTS AND DISCUSSION

The absorption maxima were found to be 238 nm for Medium 1 and 239 nm for Medium 2 solution with characteristic peak as shown in figure 2. The linearity curves were constructed for (Medium 1) and (Medium 2), same were shown in figure 3. The linearity curve data was given in table 1, the Beer's law range, molar absorptivity, best fit values, regression model fit equation relative statistical data was given in table 2.A linear relationship found in the concentration range of 1-10 µg/ml for two proposed mediums viz., (Medium 1) and (Medium 2) solution.The goodness of fit study suggests good correlation coefficient (R^2 - 0.9998 and 0.9998 for proposed methods) shows the validity of Beer's law with intercept response < 2% calculated by the least square method indicating functional linearity between the concentration of analyte and the absorbance.

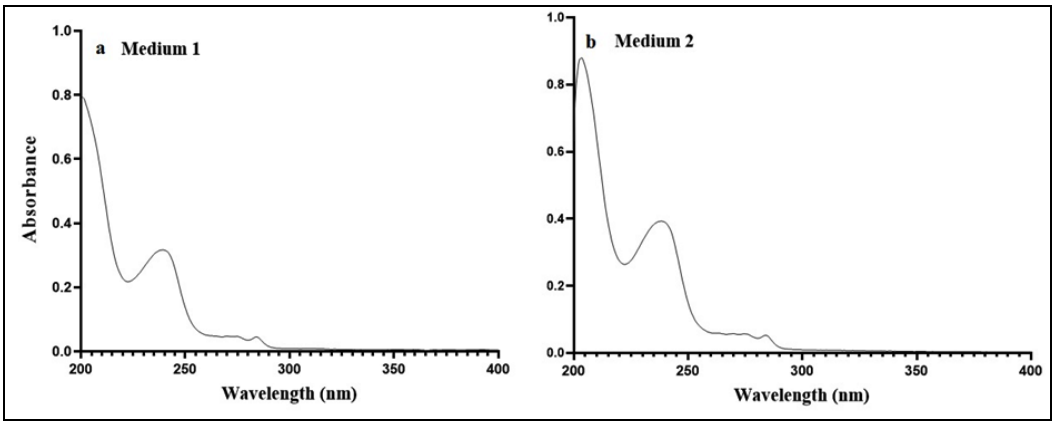

Figure 2: Absorption maxima of ESC in Medium1(a) and Medium 2 (b)

Table 1: Linearity curve data

Concentration (µg/ml)	Absorbance (n=6)			
	Medium 1		Medium 2	
	Mean	SD	Mean	SD
2	0.0687	0.0011	0.0256	0.0005
4	0.1390	0.0010	0.0533	0.0015
6	0.2057	0.0011	0.0740	0.0010
8	0.2720	0.0010	0.0960	0.0010
10	0.3417	0.0015	0.1247	0.0015

Table 2: Statistical data of linearity curve

Parameter	Medium 1	Medium 2
Absorption maxima(λmax)	238	239
Beer's range (µg/ml)	1-24	1-24
Molar absorptivity	3.420×10^{2} /(m^{-cm})	1.228×10^{2} /(m^{-cm})
Best fit values		
Slope	0.03468	0.01188
Y-intercept	0.002503	0.002267
X-intercept	-0.07218	-0.1908
1/slope	28.3	84.18

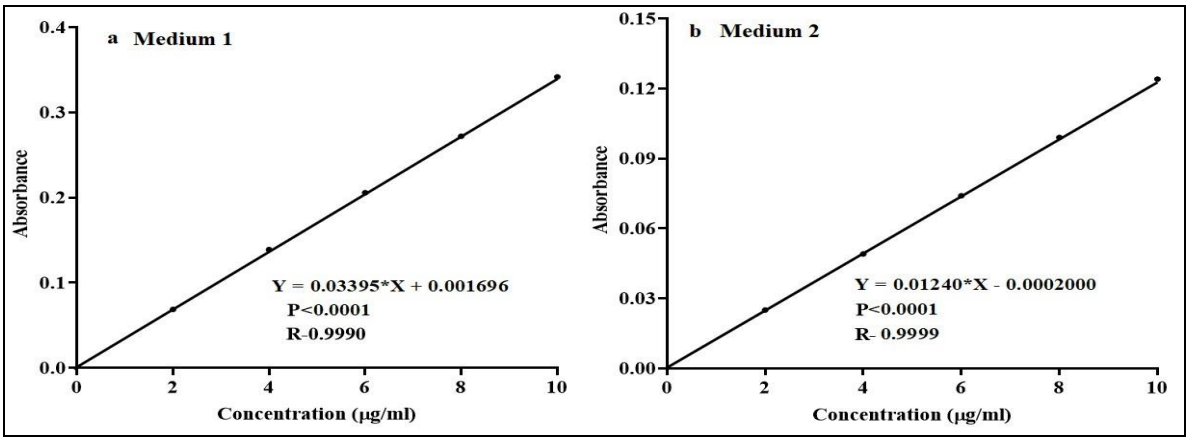

Figure 3: Linearity curve of ESC in Medium1(a) and Medium 2 (b)

LOD is the lowest amount of an analyte detected in a sample and LOQ is the lowest amount of an analyte quantified in a sample with a suitable precision and accuracy. Based on standard deviation of the response and slope, the LOD values for ESC found to be 0.0843±0.0108 µg/ml, 0.0602±0.0072 µg/ml and LOQ values found to be 0.2208±0.0102 µg/ml, 0.179±0.0072 µg/ml with % RSD values less than 2 for Medium 1 and Medium 2 respectively.

The precision of an analytical procedure expresses the closeness of agreement (degree of scatter) between a series of measurements obtained from multiple sampling of the same homogeneous sample under the prescribed conditions. Six replicates in repeatability studies, three replicates for intra and inter day studies of a fixed amount of ESC in Medium 1 and Medium 2. The SD and % RSD calculated and are given in table 3. The precision of the Medium 1 and Medium 2 were justified from the absorbance values obtained, the percentage RSD values for repeatability studies, intraday and inter day studies is less than 2 % indicate proposed mediums were precise and reproducible.

Table 3: Repeatability, Intraday and Inter day precision data

Precision parameters	Labelled claim (µg/ml)	Medium 1			Medium 2		
		Amount recovered	% Recovered Mean*±SD	% RSD	Amount recovered	% Recovered Mean*±SD	% RSD
Repeatability	10	9.922	99.92±0.316	0.3292	10.012	100.12±0.6231	0.8921
Intra day	10	10.001	100.1±0.7227	0.7322	9.954	99.54±0.7813	0.7822
Inter day	10	9.989	99.89±0.3123	0.3216	9.962	99.62±0.6424	0.6541
* In each case six replicates were studied n=6							

The accuracy of Medium 1 and Medium 2 analyzed for assay in two marketed tablet formulations and data given in table 4. The percentage recovery was within the permissible limit with RSD values less than 2%. The accuracy performed for the proposed mediums by standard addition method and the % recovery found within the permissible limits with RSD values less than 2% indicate non-interference of the excipients in the formulations. The ESC content of two marketed products determined by the proposed mediums was in good agreement with the label claim with % RSD values less than 2 and data given in table 5.

The robustness and ruggedness data given in tables 6,7. Change in λ max of ± 5 nm to the actual λ max in robust analysis results significant different in the absorbance values when compared to actual values in both Medium1 and Medium 2 indicates the mediums were robust. In ruggedness, analysis by different analyst and change of instrumentindicates the proposed methods were significantly rugged.

The results of stability study of ESC in Medium 1 and Medium 2 were within the acceptable limit and indicate solutions in proposed methods stable over the period of 48 hr.

Table 4: Assay data of ESC in marketed tablets in Medium 1 and Medium 2

Brand name	Labelled claim	Amount recovered (µg/ml)	% Recovery Mean ± SD	% RSD
Medium 1				
Bhartiya Jan Aushadhi 20mg	8 10	7.9 9.8	99.38±0.060 98.33±0.750	0.060 0.762
Nescital 10mg	8 10	7.9 9.9	99.48±0.659 99.33±0.577	0.662 0.580
Medium 2				
Bhartiya Jan Aushadhi 20mg	8 10	7.8 10.1	98.33±1.05 101.1±0.310	1.06 0.306
Nescital 10mg	8 10	7.8 9.9	98.23±0.635 99.77±0.404	0.646 0.404

Table 5: Accuracy data of marketed tablets in Medium 1 and Medium 2 by standard addition method

Brand name	Prequantified sample (µg)	% of pure drug added	Amount of Pure drug added(µg)	Amount recovered (µg)	% Recovery * Mean ±SD	% RSD
Medium 1						
Bartiya jan aushadhi 20	8	40	3.2	3.21	100.31±0.010	0.009
	8	80	6.4	6.41	100.15±0.100	0.001
	8	120	9.6	9.55	99.47±0.040	0.004
	10	40	4.0	4.02	100.5±0.060	0.390
	10	80	8.0	7.96	99.5±0.152	0.250
	10	120	12.0	11.83	98.58±0.152	0.015
Nescital 10	8	40	3.2	3.16	98.75±0.046	0.046
	8	80	6.4	6.36	99.37±0.100	0.010
	8	120	9.6	9.57	98.78±0.057	0.057
	10	40	4.0	3.92	98.83±0.110	1.390
	10	80	8.0	7.89	98.62±0.005	0.033
	10	120	12.0	11.92	99.33±0.050	0.011
Medium 2						
Bartiya jan aushadhi	8	40	3.2	3.19	99.68±0.005	0.058
	8	80	6.4	6.38	99.68±0.057	0.250
	8	120	9.6	9.49	98.85±0.025	0.039
	10	40	4.0	4.02	100.5±0.04	0.096
	10	80	8.0	8.03	100.37±0.041	1.010
	10	120	12.0	12.02	100.16±0.025	1.100
Bartiya jan aushadhi	8	40	3.2	3.17	99.06±0.046	0.028
	8	80	6.4	6.37	99.53±0.040	0.068
	8	120	9.6	9.61	100.10±0.09	1.060
	10	40	4.0	3.95	98.75±0.07	0.038
	10	80	8.0	7.89	98.62±0.17	0.058
	10	120	12.0	11.97	99.75±0.20	0.068

Table 7: Robustness data for proposed methods

λ_{max}	Concentration µg/ml	Absorbance Mean±SD	% RSD values
Medium 1			
Actual 238nm	8	0.272±0.001	0.003
	10	0.341±0.001	0.002
233nm(-5nm)	8	0.251±0.004	0.015
	10	0.321±0.002	0.006
243nm(+5nm)	8	0.282±0.002	0.007
	10	0.334±0.020	0.059
Medium 2			
Actual 239nm	8	0.096±0.001	0.010
	10	0.124±0.001	0.008
234nm(-5nm)	8	0.085±0.004	0.047
	10	0.116±0.001	0.008
244nm(+5nm)	8	0.106±0.001	0.009
	10	0.134±0.002	0.014

Table 8: Ruggedness data for proposed methods

Parameter	Concentrationµg/ml	AbsorbanceMean ± SD	% RSDvalues
Medium 1			
Analyst 1	8	0.277±0.002	0.007
	10	0.345±0.001	0.002
Analyst 2	8	0.273±0.001	0.003
	10	0.347±0.005	0.014
Medium 2			
Analyst 1	8	0.094±0.001	0.010
	10	0.126±0.001	0.007
Analyst 2	8	0.096±0.001	0.010
	10	0.123±0.001	0.008

CONCLUSION

The results and the statistical parameters demonstrate that the proposed mediums for spectrophotometric methods are simple, rapid, specific, accurate and precise. Therefore, this method can use for the quantification of Escitalopram Oxalate in tablet dosage formulations without interference with commonly used excipients and related substances.

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CONFLICT OF INTERESTS

No conflict of interest

REFERENCES

1. Sanchez C, Reines EH, Montgomery SA. A comparative review of escitalopram, paroxetine, and sertraline: Are they all alike? Int Clin Psychopharmacol 2014; (4):185-196.
2. Baldwin DS, Asakura S, Koyama T, Hayano T, Hagino A, Reines E et al. Efficacy of escitalopram in the treatment of social anxiety disorder: A meta-analysis versus placebo. Eur J Neuropsychopharmacol2016; (6):1062-1069.
3. Bandelow B, Reitt M, Rover C, Michaelis S, Görlich Y, Wedekind D. Efficacy of treatments for anxiety disorders: a meta-analysis. IntClin Psychopharmacol2015;(4):183-192.
4. SuneethaA, SyamaSB. A validated UV spectrophotometric method for estimation of Escitalopram Oxalate in bulk and pharmaceutical dosage forms.Asian JResChem2010; 3(4):935-937.
5. ChaudhariBG, ParmarHR. Spectrophotometric method for determination of Escitalopram Oxalate from tablet formulations. IntJPharmQuality Ass2010; 2(1):9-12.
6. Vetrichelvan T, Arul K, Sumithra M, Umadevi B. Colorimetric method for the estimation of Escitalopram Oxalate in tablet dosage form. IndJPharmSci2010; 72(2):269-271.
7. KakdeRB, SatoneDD. Spectrophotometric method for simultaneous estimation of Escitalopram Oxalate and Clonazepam in tablet dosage form. IndJPharmSci2009; 71(6):702-705.
8. SharmaS, RajpurohitH, SonwalC, SharmaP, BhandariA. Simultaneous spectrophotometric determination of Escitalopram Oxalate and Clonazepam using multi-component mode of analysis. JPharmRes2010; 3(9):2303-2305.
9. SakhreliyaBD, TrivediPD, ModiDK. Development and validation of spectrophotometric methods for simultaneous estimation of Escitalopram Oxalate and Etizolam in their combined tablet dosage form. JPharmSciBiosciRes2012; 2(5):195-200.
10. SyamaSB. Spectroscopic method validation of liquid chromatographic method for estimation of Escitalopram Oxalate in tablet dosage forms. IntJPharmaBiosci2011; 2(1):140-146.
11. TapobanaS, Suddhasattya D, HimansuBS, BharatD, Dibya LM, KaushikB. RP-HPLC method for the estimation of Escitalopram in bulk and in dosage forms. IntJChemRes2011; 2(2):11-15.
12. RavisankarP, KrishnaSB, Santosh KVS, SrinivasaBP, DevalaRG. A novel validated RP-HPLC method for the determination of Escitalopram Oxalate in bulk and pharmaceutical tablet dosage form. IntJAdvPharmSci2013; 4(6):1162-1176.
13. DigheVV, PawaskarP, AdhyapakS, ShambhuN, MestryD. Development of normal phase chiral liquid chromatographic method for estimation of Escitalopram Oxalate and determination of R-citalopram enantiomer from Escitalopram Oxalate inbulk drug and tablet. JChemPharmRes2012; 4(11):4804-4809.
14. GandhiSV, DhavaleND, JadhavVY, SabnisSS. Spectrophotometric and Reversed-phase High-performance Liquid Chromatographic methods for simultaneous determination of Escitalopram Oxalate and Clonazepam in combined tablet dosage form. JAssoOffAnalChemInter2008; 91(1):33-38.
15. ChusenaNB, DevalaRG, PasupuletiU. Development and validation of an RP-HPLC method for the simultaneous determination of Escitalopram Oxalate and Clonazepam in bulk and its pharmaceutical formulations. IntCurPharmJ2012; 1(8): 193-198.
16. ChakoleRD, ChardeMS, BhavsarN, MaratheRP. Simultaneous estimation of Escitalopram and Clonazepam by RP-HPLC in pharmaceutical formulation. IntJPhytopharm2012; 2(1):25-29.
17. KakdeRB, SatoneDD, GadapayaleKK, KakdeMG. Stability indicating RP-HPLC method for the simultaneous determination of Escitalopram Oxalate and Clonazepam. JChromaSci2013; 51:490-495.
18. PatelVB, DaveJB, PatelCN. RP-HPLC method for simultaneous estimation of Escitalopram Oxalate and Etizolam in bulk and tablet dosage form. AmeJPharmTech Res2012; 2(3):1053-1061.
19. MondalP, SanthoshB, SatlaSR, RaparlaR. A new validated simultaneous RP- RP-HPLC method for estimation of Escitalopram Oxalate and Etizolam in bulk and table dosage form. Der Pharma Chemica2013; 5(3):26-32.
20. SuneethaA, Muthuprasanna P. Development and validation of HPTLC method for the estimation of Escitalopram Oxalate in bulk and pharmaceutical dosage form. IntJPharmaBio Sci2013; 4(2):504-510.
21. MahadikMV, DhaneshwarSR, KulkarniMJ. Application of stability indicating HPTLC method for quantitative determination of Escitalopram Oxalate in pharmaceutical dosage form. EurJAnalChem2007; 2(2):101-117.
22. KakdeRB, SatoneD, BawaneN. HPTLC method for simultaneous analysis of Escitalopram Oxalate and Clonazepam in pharmaceutical preparations. JPlanChrom2009; 22(6):417-420.