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Research Article

FT-IR Spectroscopic Assay Method for Eslicarbazepine Acetate in Bulk and Tablet Formulations

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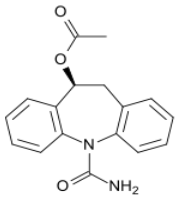
Abstract

A simple, precise and rapid FT-IR spectroscopic method has been developed for the quantification of Eslicarbazepine acetate (ECA) in bulk and tablet formulations. The method involves the measurement of absorbance of carbonyl (C=O) peak at 1726 cm^{-1} and evaluation of unknown drug component from the measured absorbance values using standard calibration plot. The method was validated as per ICH guidelines and successfully applied for the estimation of ECA in pharmaceuticals in tablet form.
Keywords: FT-IR, Eslicarbazepine Acetate, Absorbance, Tablet formulation.

1. Introduction

Chemically, Eslicarbazepine Acetate (ECA) is (S)-10-Acetoxy- 10,11-dihydro- 5H-dibenz[b,f]azepine- 5-carboxamide and is used as an anticonvulsant or antiepileptic drug. It is a prodrug which is activated to eslicarbazepine (S-licarbazepine), an active metabolite of oxcarbazepine. ECA may be used to treat bipolar disorder and trigeminal neuralgia. Many methods were available in literature for its determination in single dosage form[1-5] and combined dosage forms[6-9] using HPLC technique, but methods for its determination using Infrared Spectroscopy technique were not available. Hence an attempt was made to develop a simple, rapid and non-destructive method using FT-IR for the assay of Eslicarbazepine Acetate (ECA) in pure and tablet forms.

Figure 1: Chemical structure of Eslicarbazepine Acetate (ECA)



2. Materials and Methods

2.1 Materials

Potassium Bromide (Spectroscopic grade) obtained from Sigma-Aldrich. Single dosage form tablets Eslizen 400 with a label claim 400mg were procured from local market, Hyderabad, India.

2.1.1. FT-IR Instrumentation: Highly sophisticated bench top Thermo Nicolet, Nexus 670 FT-IR, USA, Spectrometer was used. It consists of Helium – Neon laser Class IIa, DTGS Detector, KBr Beam splitter. Full length spectral range (4000cm^{-1} to 400cm^{-1}) was scanned during the experiment. All the spectra were recorded by averaging 32 scans with a resolution of 4cm^{-1}. Data collection was automated using OMNIC software.

2.2. Methods

2.2.1. Preparation of Eslicarbazepine acetate standard: Five tablets of Eslicarbazepine acetate were taken and ground to a fine powder. Then dissolved in 20ml of Methanol and filtered the solution through Whatman filter paper no.42. Extraction was repeated for 2-3 times using 20ml of methanol. The solvent was removed using rotavapour and dried completely to get fine powder. The purity of the final product was checked by HPLC. The purity of the compound was found to be 99%.

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2.2.2. Calibration: For calibration, the KBr discs were prepared by compressing the standard substance (ECA) in spectral grade KBr in the concentration range 0.13mg to 0.40mg and recorded the spectra.

2.2.3. Sample preparation and formulation analysis: Ten tablets of Eslizen 400 were weighed and ground to a fine powder. A known quantity of it equivalent to the concentration of the individual drug in the calibration range was compressed with spectral grade KBr. Five KBr discs of different concentrations were prepared and spectra were recorded. The unknown concentrations of the drug were estimated from the measured absorbance at 1726cm^{-1} using calibration plots.

3. Results

3.1. Validation Parameters

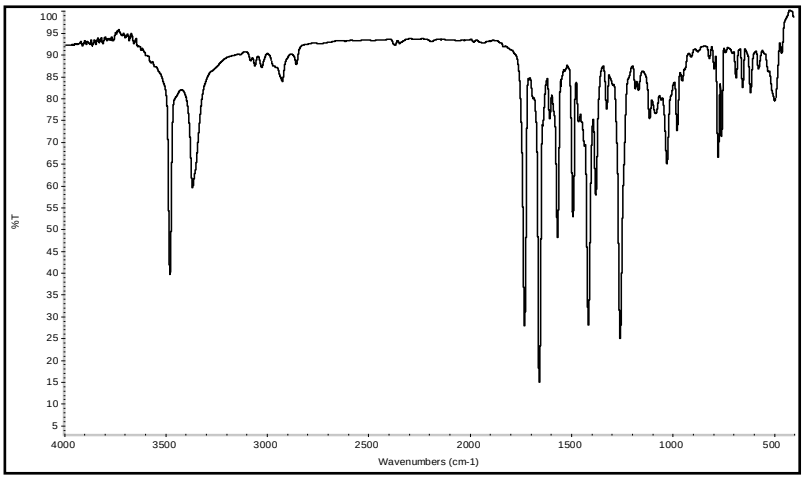
Table 1: Validation parameters data

Parameter	Data
Linearity (mg)	0.13-0.40
R^2	0.9986
Linear Regression Equation	Y= 0.01622 + 0.94727 x
Slope (B)	0.94727
Intercept (A)	0.01622
LOD (mg)	0.005
LOQ (mg)	0.016

3.2. FT-IR Spectra

The FT-IR spectrum of pure Eslicarbazepine acetate (ECA) by KBr pellete method is given in Figure 2. The compound exhibited strong sharp signal at 1726cm^{-1} which is due to the absorption of carbonyl group (C=O)**.**

Figure 2: FT-IR spectrum of Eslicarbazepine acetate (ECA) standard



A calibration has been carried out for ECA using known quantities of standard as mentioned in 2.2.2. The calibration plot and the overlain spectrum were shown in Figure 3&4**.**

Figure 3: Calibration plot of Eslicarbazepine acetate (ECA) standard

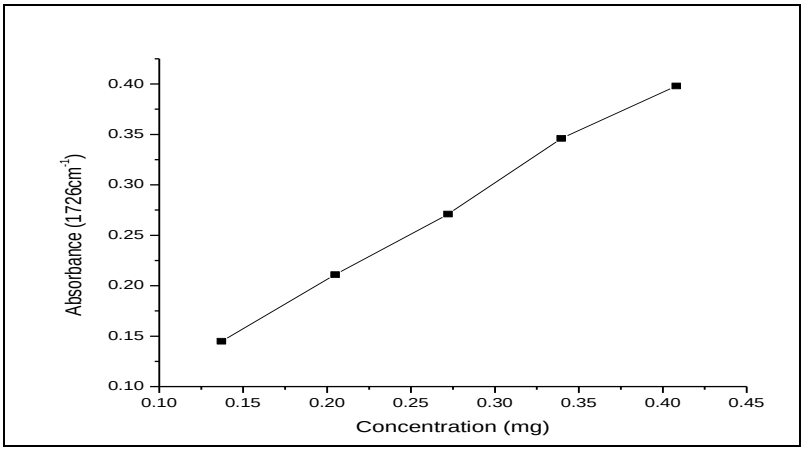
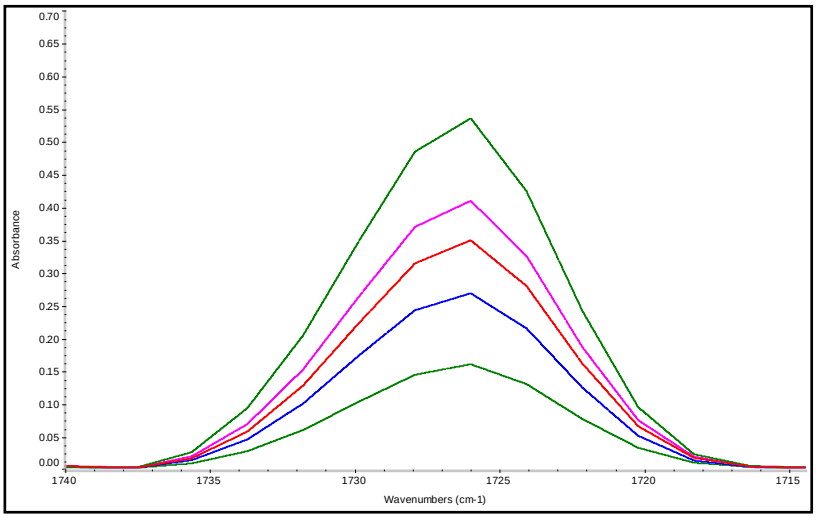


Figure 4: Eslicarbazepine acetate (ECA) standard –overlain spectra of five different concentrations



The method was applied to single dosage formulation and the spectrum was recorded for Eslizen 400 tablet. It is observed that the peak 1726cm^{-1} is free from interferences from other compounds present in the tablet (excipients).

3.3. Accuracy Studies

Recovery studies were carried out by the addition of known amount of pure drug to the preanalysed sample and analysed by the proposed method at two different concentration levels 50% and 100%. Accuracy of the reported method was estimated in terms of % recovery of ECA from tablet formulation and given in Table 2.

Table 2: Accuracy studies

Level (%)	Stand Conc. (mg)	Amount added (mg)	Total amount (mg)	Amount recovered[a]	Mean % recovery	%RSD
50	400	200	600	603.00	100.50	0.61
100	400	400	800	799.30	99.91	0.26

[a]Average of 5 determinations

3.4. Precision Studies

Intra-day & inter-day precision experiments were performed. Intraday studies were conducted within a time interval of 2 hours in a day and inter-day studies were conducted on alternate days for 3 times. The % recovery was calculated and shown in Table 3.

Table 3: Precision studies

Taken Conc. (mg)	Intraday (%Recovery)	Taken Conc. (mg)	Inter-day (%Recovery)
0.1949	100.05	0.1954	99.80
0.1946	100.20	0.1945	100.25
0.1982	100.90	0.1947	100.15
Mean	100.38	Mean	100.06
%RSD	0.45	%RSD	0.23

3.5. Ruggedness

Ruggedness was carried out by two different analysts. One analyst carried out four experiments at a concentration of 0.25mg in every two hours. The prepared pellets were scanned and absorbance values were noted.

Table 4: Ruggedness data

S. No.	Analyst-I		Analyst-II	
	Taken Conc. (mg)	OD (1726cm^{-1})	Taken Conc. (mg)	OD (1726cm^{-1})
Expt.1	0.2546	0.256	0.2537	0.256
Expt.2	0.2535	0.256	0.2530	0.254
Expt.3	0.2536	0.255	0.2534	0.255
Expt.4	0.2540	0.254	0.2540	0.255
	%RSD	0.19	%RSD	0.16

3.6. Recovery studies of commercial formulations

The recovery and % RSD (η=5) for commercial tablet Eslizen 400 were calculated. The % RSD was found to be <2. The recovery was found to be >99%.

Table 5: Recovery studies of commercial formulations

Tablet	Label claim (mg)	% assay*	%RSD
		100.66	0.39
		99.65	0.80
ESLIZEN 400	400	100.71	0.84
		100.14	0.78
		101.45	1.01

*Average of 5 determinations

4. Discussion

4.1. Linearity

The linearity of the method was in the concentration range from 0.13mg – 0.40mg. The linearity of the investigation was done by measuring the peak absorbance of the drug at 1726 cm^{-1} at different concentrations (0.13mg – 0.40mg). Calibration plot was constructed by plotting peak absorbance against the concentration of the drug. The results revealed that the drug followed Beer-Lamberts law in the concentration range studied. The correlation coefficient (R^2) was found to be 0.9986.

4.2. LOD and LOQ

The limit of detection (LOD) is the concentration of an analyte in a sample that has a signal-to-noise ratio of 3:1 and the limit of quantification (LOQ) is the concentration of an analyte in a sample that can be quantitated which has a signal-to-noise ratio of 10:1. Both LOD and LOQ were experimentally verified and calculated using the following equation.

$$LOD = 3.3 (SD/Slope)$$

$$LOQ = 10 (SD/Slope)$$

The LOD & LOQ were 0.005mg and 0.016mg respectively.

4.3. Precision

Precision study was performed by taking five determinations for each concentration and %RSD was calculated. The % RSD values were <1, indicating the method was precise.

4.4. Accuracy

The %recovery was between 99-100.5 and %RSD was found to be less than 1. This indicates that the developed method is precise for direct determination of ECA.

4.5. Ruggedness

The %RSD was found to be less than 1. No significant differences were found when the analysis was repeated after 48 hours by another analyst. The results obtained on different days indicated that this method is capable of analyzing the drug under study in single dosage formulations with good precision.

5. Conclusion

In the present investigation we have studied the possibility of quantification of drug component in single dosage formulation using FT-IR. From the data it is clear that FT-IR is capable of direct determination of ECA in the above formulations. The proposed FT-IR method was found to be simple, rapid, reproducible and less time consuming compared to the methods already exist in literature.

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