*Asian Journal of Chemistry* Vol. 21, No. 5 (2009), 3463-3466

# Spectrophotometric Estimation of Ceftibuten in Pharmaceutical Formulations

K. SRINIVASU†, J. VENKATESWARA RAO*, N. APPALA RAJU and K. MUKKANTI†
*Department of Pharmaceutical Chemistry, Sultan-Ul-Uloom College of Pharmacy*
*Mount Pleasant, Road No. 3, Banjara Hills, Hyderabad-500 034, India*
*E-mail: jvrao1963@yahoo.co.in*

Three simple, accurate, rapid and sensitive methods (A, B and C) have been developed for the estimation of ceftibuten in its pharmaceutical dosage form. The method A is based on reaction of ceftibuten with ferric chloride and 1,10-phenanthroline to form a blood red coloured chromogen. The method B is based on reaction of ceftibuten with ferric chloride with 2,2'-bipyridyl to form blood red coloured chromogen. These methods exhibit maximum absorption at 510 and 520 nm, respectively and obey the Beer's law in the concentration range of 0.125-2.5 and 0.065-2.0 mcg/mL respectively. Method C based on reaction of ceftibuten with ferric chloride and potassium ferricyanide produces blue coloured chromogen having a maximum absorbance at 720 nm. The methods have been statistically evaluated and were found to be precise and accurate. The proposed methods are economical and sensitive for the estimation of ceftibuten in bulk drug and in its formulations.

**Key Words: Spectrophotometry, Ceftibuten, 1,10-Phenanthroline, 2,2'-Bipyridyl, Ferric chloride.**

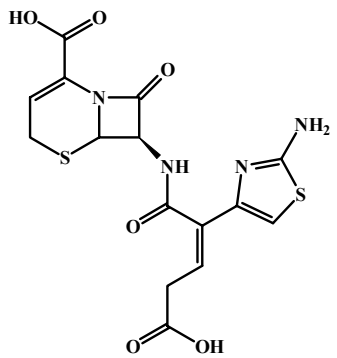
## INTRODUCTION

Ceftibuten[1] is chemically [6R-6α-7β(R*)]-7-[α-amino-4-hydroxy phenyl)-acetyl]amino]-8-oxo-3-(1-propenyl)-5-thia-1-azabicyclo[4.2.0]oct-2-ene-2-carboxylic acid monohydrate. It is a third generation cephalosporin effective against gram-positive and gram-negative bacteria, including both aerobes and anaerobes. It is indicated for complicated upper and lower urinary tract infections, respiratory tract infections, skin and soft tissue infection and bacteraemia. It is official in martindale-the extra pharmacoepia[2]. Literature survey reveals that the drug is determined by using HPLC[3-5] and no spectrophotometric methods has been reported for the determination of ceftibuten in pharmaceutical dosge forms. The present study describes simple, sensitive, accurate, rapid and economical spectrophotometric methods A, B and C for the estimation of ceftibuten in its formulations.

†Institute of Science and Technology, Jawaharlal Nehru Technological University, Kukatpally, Hyderabad-500 072, India.

## EXPERIMENTAL

Elico ultraviolet-visible double beam spectrophotometer SL-164 with 1 cm matched quartz cells was used for all spectral measurements.




Structure of the ceftibuten

All the chemicals used were of analytical reagent grade. (i) 1,10-Phenanthroline (0.2 M): 990 mg of 1,10-phenanthroline is dissolved in 25 mL of distilled water. (ii) Ferric chloride hexahydrate (0.03 M): 405 mg of Ferric chloride hexahydrate is dissolved in 50 mL of distilled water. (iii) 2,2'-Bipyridyl (0.2 M): 780 mg 2,2'-bipyridyl in 25 mL of in distilled water. (iv) Ferric chloride hexahydrate (0.3 % w/v): 300 mg of ferric chloride hexahydrate was dissolved in 100 mL of distilled water. (v) Ferric chloride hexahydrate: 0.3 % (w/v) in distilled water. (vi) Potassium ferricyanide: 0.2 % (w/v) in distilled water.

**Procedure:** Standard stock solution was prepared by dissolving about 50 mg of ceftibuten in 100 mL of distilled water to get a concentration of 500 mcg/m. This was further diluted to get the working standard solution of 1.25 mcg/mL and 5 mcg/mL.

### Assay procedure

**Method A:** Aliquots of standard drug solution of ceftibuten 1-2 mL (1.25 mcg/mL) and 1-5 (5 mcg/mL) were taken and transferred into series of graduated test tubes. To each test tube 1 mL of ferric chloride hexahydrate (0.03 M) and 1 mL of 1,10-phenanthroline (0.2 M) were added. The test tubes were allowed to stand in water bath at 70 ºC for 15 min. The test tubes were then cooled to room temperature and the solutions were made upto 10 mL with distilled water. The absorbance of the red coloured chromogen was measured at 510 nm against reagent blank and a calibration curve was constructed. The absorbance of the sample solution was measured and the amount of ceftibuten was determined by referring to the calibration curve.

**Method B:** Aliquots of standard drug solution of ceftibuten 0.5-2.0 mL (1.25 mcg/mL) and 1-4 (5 mcg/mL) were taken and transferred into series of graduated test tubes. To each test tube 1 mL of ferric chloride hexahydrate (0.03 M) and 1 mL of 2,2'-bipyridyl (0.2 M) were added. The test tubes were allowed to stand in water bath at 70 ºC for 15 min. The test tubes were then cooled to room temperature and

the solutions were made upto 10 mL with distilled water. The absorbance of the red coloured chromogen was measured at 520 nm against reagent blank and a calibration curve was constructed. The absorbance of the sample solution was measured and the amount of cefibuten was determined by referring to the calibration curve.

**Method C:** Aliquots of standard drug solution of cefibuten 0.5-5.0 mL (20 mcg/mL) were taken and transferred into series of graduated test tubes. To each test tube 1 mL of ferric chloride hexahydrate (0.3 % w/v) and 0.5 mL of potassium ferricyanide (0.2 % w/v) were added and thoroughly shaken and set aside for 5 min. The volume in each test tube was made upto 10 mL with distilled water. The absorbances of the solutions were measured at 720 nm against reagent blank, within 0.5 h and the calibration curve was plotted. Similarly the absorbance of the sample solution was measured and the amount of cefibuten was determined by referring to the calibration curve.

The methods were extended for the determination of ceftibuten in tablets (Cedax 400 mg, Shionogi USA INC) was choosen. Twenty tablets of cefibuten were accurately weighed and powdered. Tablet powder equivalent to 100 mg of cefibuten was dissolved in 50 mL of distilled water, sonicated for 15 min, filtered and washed with distilled water. The filtrate and washings were combined and the final volume was made to 100 mL with distilled water. The solution was suitably diluted and analyzed as given under the assay procedure for bulk samples.

The results are represented in Table-2. None of the excipients usually employed in the formulation of tablets interfered in the analysis of ceftibuten, by the proposed methods.

**Recovery studies:** To ensure the accuracy and reproducibility of the results obtained, adding known amounts of pure drug to the previously analyzed formulated samples and these samples were reanalyzed by the proposed method and also performed recovery experiments. The percentage recoveries thus obtained were given in Table-2.

## RESULTS AND DISCUSSION

In the present study, the method A and B are based on the reduction of ferric chloride to ferrous form by the drug, which forms complex with 1,10-phenanthroline and 2,2'-bipyridyl to yield blood red coloured chromogen. The coloured chromogens were stable for more than 3 h and exhibited maximum absoption at 510 and 520 nm, respectively. In the method C, the estimation is based on the reduction of ferric ions to ferrous ions by the drug, which further in the presence of potassium ferricyanide produces blue coloured chromogen having a maximum absorbance at 720 nm. The blue coloured chromogen was stable for 0.5 h at room temperature.

The conditions required for the formation of coloured complexes were optimized. Statistical analysis was carried out and the results of which were satisfactory. The optical characteristics such as absorption maxima, Beer's law limits, molar absorptivity and Sandell's sensitivity are presented in Table-1.

TABLE-1
OPTICAL CHARACTERISTICS AND PRECISION DATA

| Parameters | Method A | Method B | Method C |
|---|---|---|---|
| $\lambda_{max}$ (nm) | 510 | 520 | 720 |
| Beer's law limits mcg/mL | 0.125-2.5 | 0.125 - 2 | 1-10 |
| Molar absorptivity (L/mol cm) | $1.31\times10^4$ | $6.96\times10^5$ | $1.95\times10^4$ |
| Sandell's sensitivity (μg/cm$^2$/0.001 absorbance unit) | 0.0042 | 0.0039 | 0.4104 |
| Regression equation* (Y) | | | |
| Slope (m) | 0.4360 | 0.4630 | 0.0100 |
| Intercept (c) | 0.0490 | 0.0050 | 0.0122 |
| Correlation coefficient (r) | 0.9987 | 0.9965 | 0.9998 |
| Precision (% Relative standard deviation) | 0.4190 | 0.4600 | 0.5620 |
| Standard error of mean | 0.0019 | 0.0020 | 0.0345 |
| % Range of error (confidence limits) | | | |
| 0.05 level | 0.1339 | 0.1350 | 0.9200 |
| 0.01 level | 0.1347 | 0.1310 | 0.7700 |

*Y = mx+c, where X is the concentration in μg/mL and Y is absorbance unit.

TABLE-2
ASSAY OF CEFIBUTEN IN PHARMACEUTICAL FORMULATION

| Sample No. | Labelled amount (Tablet) (mg) | % Obtained by proposed method (mg) | | | **% Recovery by the proposed method | | |
|---|---|---|---|---|---|---|---|
| | | Method A | Method B | Method C | Method A | Method B | Method C |
| 1 | 400 | 398.3 | 399.2 | 400.5 | 98.8 | 99.9 | 100.2 |
| 2 | 400 | 399.8 | 400.3 | 401.6 | 100.1 | 99.6 | 100.5 |

*Average of three determinations. ** After spiking the sample.

The regression analysis using the method of least squares was made for slope (m), intercept (b) and correlation obtained from different concentrations and the results are summarized in Table-1.

The reproducibility and precision of the methods are very good as shown by the low values of coefficient of variance (CV). Recovery studies were close to 100 % that indicates the accuracy and precision of the proposed methods and also indicates non-interferences from the formulation excipients. All the validated parameters are summarized in Table-2.

## REFERENCES

1. S. Budhavari, The Merck Index, Merck Research Laboratories, New Jersey, edn. 13 (1953).
2. C.S. Sweetman, Martindale-The Complete Drug Reference, edn. 34, p. 179 (2005).
3. J.M. Lim, H. Kim, A. Marco, P. Mojaverin and C.C. Lin, *J. Pharm. Biomed. Anal.*, **12**, 699 (1994).
4. H.T. Pan, P. Kumari, J.A. de Silva and C.C. Lin, *J. Pharm. Sci.*, **82**, 52 (1993).
5. A. Matsuura, T. Nagayama and T. Kitagawa, *J. Chromatogr.*, **494**, 231 (1989).

(*Received*: 1 May 2008; *Accepted*: 5 February 2009) AJC-7213