

NOTE**Spectrophotometric Determination of Certain Cephalosporins**

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A simple and specific method for the quantitative determination of cephalosporins, namely ceftriaxone, cefoperazone, cefazidime and ceftizoxime was developed. The method was based on the formation of a blue coloured chromogen, when the drug solutions react with Folin-Ciocalteu reagent in an alkaline medium.

Key Words: Spectrophotometric determination, Cephalosporins.

These cephalosporins are used for mild to moderate infections caused due to susceptible micro-organisms¹. These drugs are official in USP². Literature survey revealed few colorimetric³⁻⁶ methods and HPLC⁷⁻⁹ methods for the estimation of these drugs. In the proposed method, Folin-Ciocalteu reagent was used and a simple and sensitive method was developed which could be used for the routine analysis of these cephalosporins. The method was based on the formation of a blue coloured chromogen when the drug solutions were treated with Folin-Ciocalteu (F-C) reagent in the presence of 20% sodium carbonate.

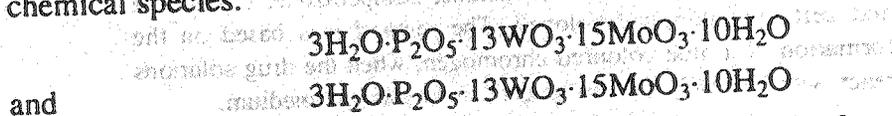
F-C reagent was prepared as per the method of Rao *et al.*¹⁰ and diluted with distilled water in the ratio of 1 : 2. Sodium carbonate (20%) was prepared by dissolving requisite amounts of sodium carbonate in distilled water, filtered and used.

Standard and sample solution: About 100 mg of each of the cephalosporins was separately taken and dissolved in distilled water and the volume was made up to the mark in a 100 mL volumetric flask. Each of the cephalosporins mentioned was separately analyzed. Dry powder for injection was the formulation that was analyzed. From the stock solution, dilutions was prepared so as to get 100 µg/mL concentration for ceftriaxone, cefoperazone and ceftizoxime and for ceftazidime 80 µg/mL was prepared.

Recommended procedure: For each of the cephalosporins analyzed one variable at a time method was followed, so the amount of F-C reagent and sodium carbonate solution added varied. Aliquots of the drug solution ranging from 0.5–3.0 mL were transferred into a series of 10 mL calibrated volumetric flasks.

Then 2.0 mL of F-C reagent followed by 1.5 mL of sodium carbonate was added. For ceftriaxone sodium, 2.0 mL of F-C reagent and 3.0 mL of sodium carbonate was added. In the case of ceftazidime, 3.0 mL F-C reagent followed by 2.5 mL of sodium carbonate and for ceftizoxime 1.5 mL of F-C reagent followed by 2.5 mL of sodium carbonate was added. In all the cases, the flasks were thoroughly mixed and allowed to stand for 10 min and finally the volume was made up to 10 mL with distilled water. The absorbance of the blue coloured chromogen was measured against a reagent blank.

The mixed acids present in Folin Ciocalteu reagent involve the following chemical species:



These cephalosporins probably bring about a reduction of 1, 2 or 3 oxygen atoms from tungstate and/or molybdate present in F-C reagent, thereby producing one or more of the reduced species which have a characteristic intense blue colour.

The four cephalosporins under study formed a blue coloured chromogen with F-C reagent in the presence of sodium carbonate and a reaction time of 10 min was allowed for colour development. Experiments were carried out to study the effects of varying concentrations of sodium carbonate solution; these showed that at low concentrations of sodium carbonate, the solutions attained a yellow tinge and at higher concentrations either there was no significant change in absorbance or the absorbance decreased. A similar study with F-C reagent showed that at low concentration, the colour developed was not complete and at higher concentrations of F-C reagent the absorbance attained was very high. The order of addition of reagents was also studied and it showed that altering the order of addition of reagents did not have any adverse effect on the colour development.

The optical characteristics such as Beer's law limits, Sandell's sensitivity, molar extinction coefficient, per cent relative standard deviation and % range of error are summarized in Table-1.

TABLE-1
OPTICAL CHARACTERISTICS AND PRECISION

Parameters	Cefoperazone	Ceftriaxone	Ceftazidime	Ceftizoxime
λ_{max} (nm)	652	728	731	731
Beer's law limit ($\mu\text{g/mL}$)	5-30	5-25	4-20	5-25
Molar absorptivity ($\text{L mol}^{-1} \text{cm}^{-1}$)	11.67×10^4	10.124×10^4	9.48×10^4	10.036×10^4
Sandell's sensitivity ($\mu\text{g/cm}^2/0.001 \text{ abs unit}$)	0.0333	2.604 X	0.04099	0.38737
Correlation coefficient (r)	0.9999	1.002	0.9994	0.9996
Regression equation (Y)*				
Slope (a)	0.0298	0.3921	0.0508	0.02568
Intercept (b)	3.89×10^{-3}	0.01448	5.46×10^{-3}	8.62×10^{-3}

Y = a + bC where C is the concentration of the cephalosporin.

The regression analysis using the least squares was made for slope (a), intercept (b) and correlation coefficient (r) obtained from different concentrations and the results are summarized in Table-1. The data obtained from the determination of the cephalosporins in pharmaceutical formulations by the proposed method are computed in Table-2. To evaluate the validity and reproducibility of the method, known amount of pure drug was added to the previously analyzed pharmaceutical formulations. The % recovery is summarized in Table-2.

TABLE-2
ESTIMATION OF THE CEPHALOSPORINS IN DOSAGE FORM

Drugs	Labelled amount (mg/tab)	Amount obtained (proposed method)	Recovery (%)
Cefriaxone	250	249.89	98.04
	500	499.78	98.08
Cefoperazone	250	250.04	99.98
	1000	1007.05	98.98
Ceftizoxime	1000	1003.76	94.57
Ceftazidime	250	253.90	100.18
	500	503.75	100.75

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