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Research Article

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Spectrophotometric Determination of Cr (III) and Fe (III) by Cephalexin

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Abstract In this work cephalexin and its Cr (III) and Fe (III) metal complexes determination were carried out by spectrophotometric method. The following experimental procedures like effect of pH, effect of metal ion concentration, effect of drug concentration, effect of time and the composition of the complex by mole ratio .In this research work, it is clear that Cr forms a stable 1:1 colored complex with cephalexin in acidic medium and Fe forms stable 1:1 colored complex with CFX in acidic medium. Effect of pH was studied for cephalexin - Cr (III) and cephalexin - Fe (III) complexes; it is noticed from that at pH 2.5and cephalexin - Fe (III) complexes and at pH 2.1colored complexes were formed. Effect of time clearly suggest.

Keywords Spectrophotometric Determination, cephalexin, Iron, Chromium

Introduction

The cephalosporins are β-lactam antibiotics isolated from cephalosporium species and/or prepared semi-synthetically. This comes under the class of 7-amino cephalosporonic acid (7-ACA) derivatives and are much more acid-stable than the corresponding 6-APA compounds. The cephalosporins have a mechanism of action similar to that of penicillin, mainly; they inhibit the cross-linking of the peptidoglycan units in the bacterial cell wall by inhibiting the transpeptidase enzyme. Cephalosporins metal complexes have a good interest for many researches as metallodrug [1-6]. **cephalexin**, is an antibiotic that can treat a number of bacterial infections [7]. It kills gram-positive and some gram-negative bacteria by disrupting the growth of the bacterial cell wall [7]. Cefalexin is a beta-lactam antibiotic within the class of first-generation cephalosporins [7]. It works similarly to other agents within this class. The structure of the **cephalexin** (Fig. 1) is shown below. In this research article carried out a spectrophotometric method for determination of **cephalexin**in by using chromium and Iron. In this method reaction of drug with chromium (III) and with iron (III) in acidic condition respectively to form stoichiometrically a blue **cephalexin** - Cr (III) and orange-red color **cephalexin** - Fe (III) complexes at optimum conditions. This method is convenient, simple, rapid, economically viable and selective method for the determination of drug as well as metal ions in pharmaceutical formulations.

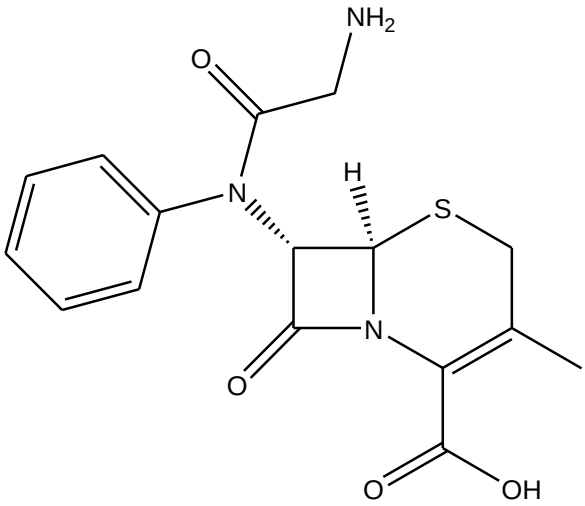

Figure 1: The structure of the cephalexin

Experimental

All the molecular absorption measurements were made using UV-Vis spectrophotometer type Shimadzu model UV-160 equipped with 10mm matched quartz cell. For pH measurement it is used a pH Meter (Elico) with combined electrode. Well calibrated glassware was used to carry out experiments. Hydrochloric acid, sodium acetate, acetic acid, ammonia, methanol, ammonium chloride, cadmium chloride and copper chloride were purchased from Merck. **Cephalexin** was purchased from Ranbaxy laboratories Ltd. All the used chemicals were of analytical reagent grade; deionized water was used for diluting the reagents and samples.

a) Absorption spectrum

5ml of buffer solution of required pH and appropriate volumes of DMF and the reagent solution are taken in a 10 mi volumetric flask. The total volume of the mixture is brought to 10 ml with distilled water. The absorbance of the solution is measured in suitable wavelength region against a blank consisting of 5 ml of buffer solution, appropriate volume of DMF and made up to the mark in 10 ml volumetric flask. A plot between absorbance and the wavelength is then made.

b) Absorption spectrum of the solution containing the complex species

In a 10 ml volumetric flask, 5 ml of buffer solution of desired pH and appropriate volumes of DMF, metal ion solution and reagent solution are taken. The contents of the flask are brought to the mark with distilled water. Its absorbance is measured in suitable wavelength region against the reagent blank prepared under identical conditions. A plot between absorbance and the wavelength is drawn from which the analytical wavelength is selected.

c) Effect of pH on the absorbance of the solution containing complex [8] species

A known aliquot of metal ion and appropriate volumes of DMF and reagent solutions are taken in different 10ml volumetric flasks each containing 5 ml of buffer solution of different pH values. The contents of each flask are made up to the mark with distilled water and the absorbance of these solutions is measured against the corresponding reagent blank at the analytical wavelength. A plot is then made between absorbance and pH, from which the working pH is chosen.

d) Effect of time on the colour development and on the stability of the [9] colour

5 ml of buffer solution, required volume of DMF, an aliquot of metal ion and the reagent solutions are taken in a 10 ml volumetric-flask and made up to the mark with distilled water. The absorbance of the solution is measured at different time intervals at the selected wavelength against the reagent blank from which the time interval required to be allowed after mixing various components of the reaction mixture and before measuring the absorbance is known.

e) Adherence of the systems to Beer's law [10]

To ascertain the sensitivity of the colour reactions and to explore the possibility of determining micro amounts of metal ions, the following procedure is adopted. Varying known aliquots of metal ion solutions are added to a set of 10ml volumetric flasks, each containing 5 ml of buffer solution of desired pH, known volume of DMF and the necessary excess of the reagent solution. The contents of the flasks are brought up to the mark with distilled water and the absorbance of the solutions are measured at the analytical wavelength against the reagent blank. A plot of absorbance and amount of metal ion(μg/ml) is constructed. The slope and the intercept of the plot are computed. The molar absorptivity is calculated from the slope.

Results and Discussion

A blue complex is formed between Cr^{3+} and Cephalexin by preparing serial concentrations for Chromium and Cephalexin. Max absorption of the band of the mixture solution at 655 nm. Therefore this wavelength was used for linear range study.

Fig(2), while molar absorptivity value (ε) of the complex with value equal22500 L $mole^{-1}cm^{-1}$ .The complex formed immediately and was determined to be stable for at least 24 h after they had formed. It is generally reported that the more points of attachment, the more stable the resulting complex., the complexes show potential for sensor design and development. From the mole ratio method it's found that the most stable formation of complex at ratio (1:1),

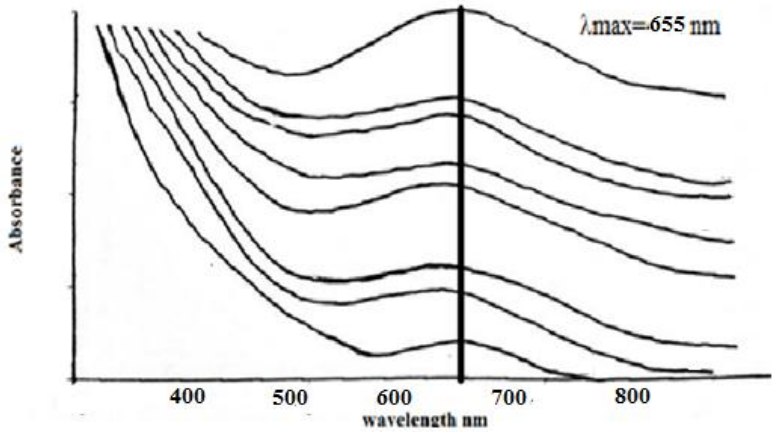

Figure 2: Spectra of different concentrations of Cr^{3+}. Cephalexin where Cephalexin has constant concentration [$5x10^{-3}$] M.

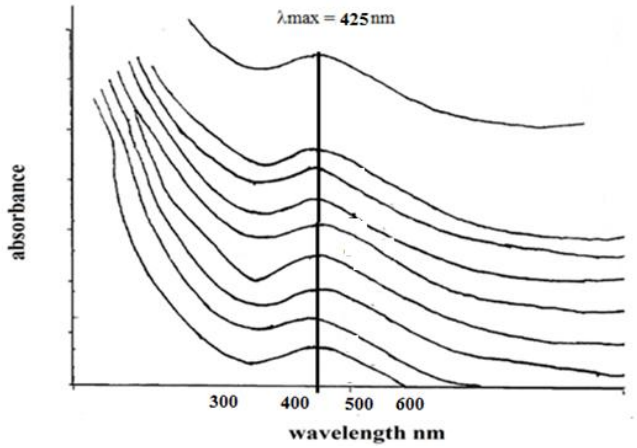

Figure 3: Spectra of different concentrations of Fe^{3+}. Cephalexin where Cephalexin has constant concentration [$5x10^{-3}$] M

Effect of Acidity

To see the effect of different pH we have taken 0.5 ppm Cr^{+3} solution. Of the various acids (nitric, sulfuric, hydrochloric and phosphoric) studied hydrochloric acid was found to be the best acid for the system. The absorbance was maximum when the pH of the solution is 2.5 at room temperature (25± 5)0C. We have controlled the pH of the solution using hydrochloric acid and ammonium hydroxide, NaOH or KOH as a base and double distilled water. Outside this range of acidity, the absorbance decreased (Fig.4). At λ_{max} **= 655 nm** the absorbance values of Cr^{+3}-cephalxin complex are as follows. At higher concentration of Cephalxin solution starts to form ppt. at pH 2.0.So we have used the lower concentrated solution (0.01% or 4.0 x 10^{-4}M) of Cephalxin., while the effect of acidity for **cephalexin** - Fe (III)we have taken 0.5 ppm Fe^{+3} solution. Of the various acids (nitric, sulfuric, hydrochloric and phosphoric) studied hydrochloric acid was found to be the best acid for the system. The absorbance was maximum when thepH of the solution is 2.1 at room temperature (25± 5)0C. We have controlled the pH ofthe solution using hydrochloric acid and ammonium hydroxide, NaOH or KOH as abase and double distilled water. Outside this range of acidity, the absorbance decreased (Fig. 5). At λ_{max} **= 425 nm** the absorbance values of Fe^{+3}-cephalxin complex are as follows. At higher concentration of Cephalxin solution starts to form ppt. at pH 2.0. So we have used the lower concentrated solution (0.01% or 4.0 x 10-4M) of Cephalxin.

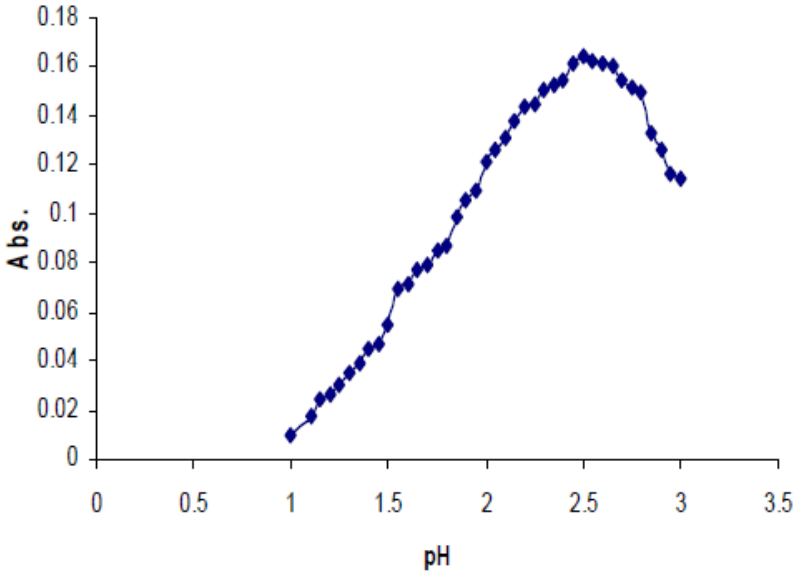

Figure 4: Effect of Acidity of cephalexin - Cr (III)

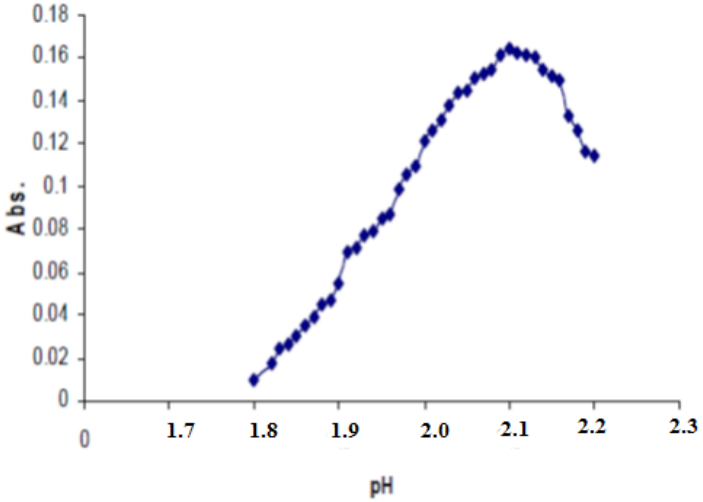

Figure 5: Effect of Acidity of cephalexin - Fe (III)

Effect of Time:

The reaction is instantaneous. Constant maximum absorbance was obtained just after diluting to volume and remained strictly unaltered for 48 hours (Fig.6). At pH over 3.0 Cr^{+3} start to form ppt with the solution of cephalxin. When the solution from ppt it go out of the measurement of spctrophotomatric analysis. We have fixed the pH at 2.5, in this pH the complex will not form ppt for the long time. We have observed sample of complex for 48 hours and constant maximum absorbance was obtained just after diluting to volume and remained strictly unaltered form beginning to end. While for Fe^{+3} Constant maximum absorbance was obtained just after diluting to volume and remained strictly unaltered for 48 hours (Fig.7). At pH over 3.0 Fe^{+3} start to form ppt with the solution of cephalxin. When the solution from ppt it go out of the measurement of spctrophotomatric analysis. We have fixed the pH at 2.1, in this pH the complex will not form ppt for the long time. We have observed sample of complex for 48 hours and constant maximum absorbance was obtained just after diluting to volume and remained strictly unaltered form beginning to end

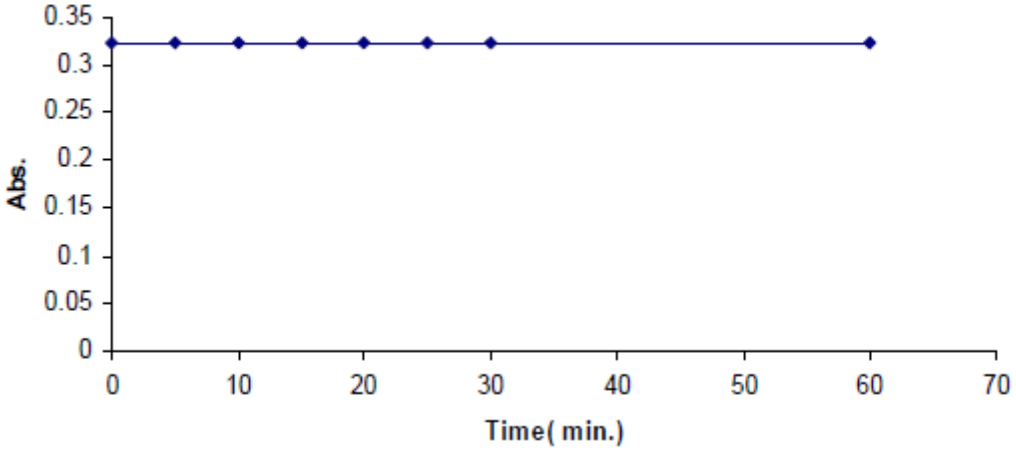

Figure 6: Effect of the time on the absorbance of Cr^{+3}-cephalxin (1:10) system

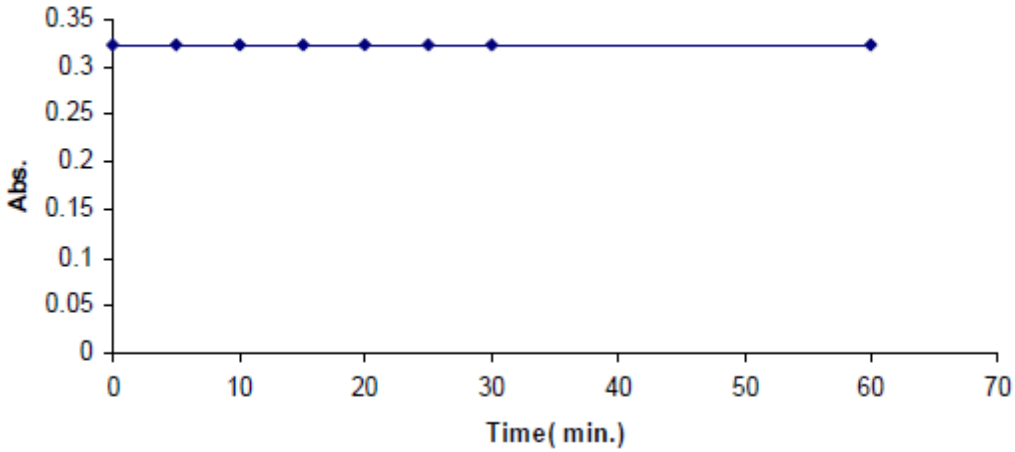

Figure 7: Effect of the time on the absorbance of Fe^{+3}-cephalxin(1:10) system

Effect of Temperature

The Cr^{+3}-cephalxin system obtained maximum and constant absorbance at room temperature (25±5) ºC. Outside this range of temperature, the absorbance decrease gradually. The results are as follows (Fig. 8):

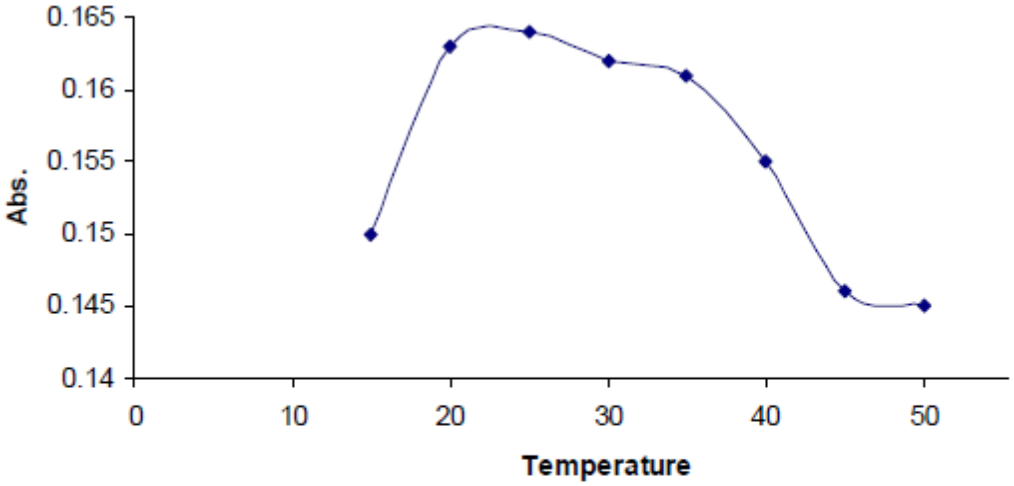

Figure 8: Effect of the temperature on the absorbance of Cr^{+3}-cephalxin

The Fe^{+3}-cephalxin system obtained maximum and constant absorbance at room temperature (25±5) ºC. Outside this range of temperature, the absorbance decrease gradually. The results are as follows (Fig. 9):

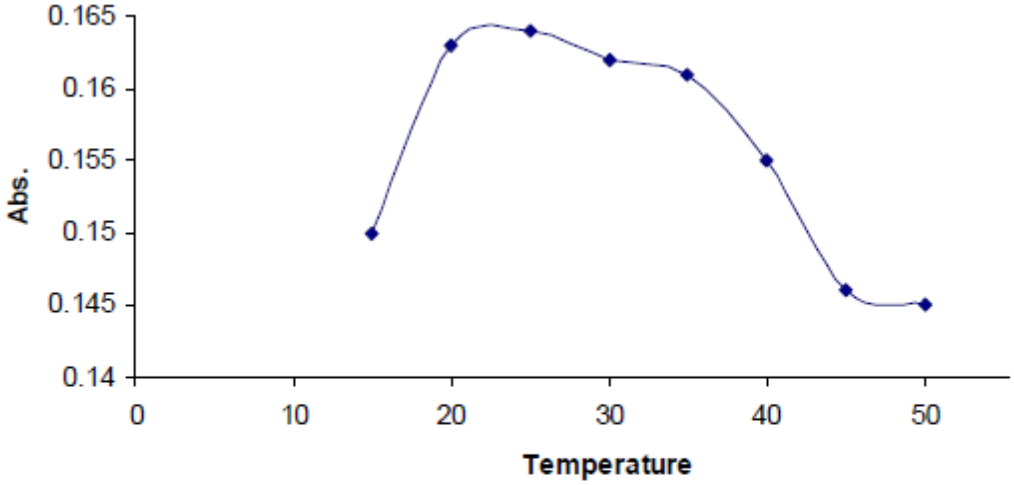

Figure 9: Effect of the temperature on the absorbance of Fe^{+3}-cephalxin

Conclusion

Thus, in this research work, it is clear that Cr^{+3} form a stable 1:1 colored complex with cephalxin in acidic medium and Fe^{+3} forms stable 1:1 colored complex with cephalxin in acidic medium. Effect of pH is studied and colored complexes were formed. From mole ratio method it clearly showed that Cr and Fe forms a stable 1: 1 complexes with cephalxin Effect of time clearly suggest , that the maximum absorbance is obtained only after heating the mixture to 40o & 60°C respectively complexes. It has been observed that the absorbance values remain constant thereafter. This method is can be used for the determination of metal ions as well as drug in pharmaceutical formulations because it is a simple, convenient and rapid technique.

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