Asian Journal of Chemistry; Vol. 23, No. 4 (2011), 1799-1801

ASIAN JOURNAL OF CHEMISTRY

www.asianjournalofchemistry.co.in

Spectrophotometric Determination of Famotidine by Cresol Red with Charge-Transfer Reaction

YING-HONG LIU*, WEI-XING MA and YAN-HUI LI

College of Chemical Engineering, Huaihai Institute of Technology, Lianyungang-222005, Jiangsu Province, P.R. China

*Corresponding author: Tel: +86 518 85857922; E-mail: liuyh9506@163.com; yinghong1978@yahoo.com.cn

(*Received*: 9 August 2010; *Accepted*: 24 December 2010) AJC-9418

A new spectrophotometric method for the determination of famotidine was carried out. The dependence of the absorbance on solvents, temperature and reaction time was investigated. In ethanolic medium famotidine reacted with cresol red to form a 1:2 charge-transfer complex with the absorbance decreased obviously at 520 nm. The decrease value of the absorbance (ΔA), due to the presence of famotidine was correlated with its concentration. Linear relationship with good correlation coefficient (0.9995) was found between ΔA and the concentration of famotidine in a concentration range of 2-61 μg mL^{-1}. The assay limit of determination was 0.28 μg mL^{-1}. The proposed method was successfully applied to the determination of the investigated drug in tablets and capsules with the recoveries of 98.0 and 99.5 %, respectively.

Key Words: Famotidine, Cresol red, Spectrophotometry, Charge-transfer reaction.

INTRODUCTION

Famotidine [3-(((2-((aminoiminomethyl)amino)-4-thiazolyl)-methyl)thio)-N'-(aminosulfonyl)propane midamide] (Fig. 1) is H_2-receptor antagonists which has been widely used for the treatment of gastric and duodenal ulcers and other related disorders.

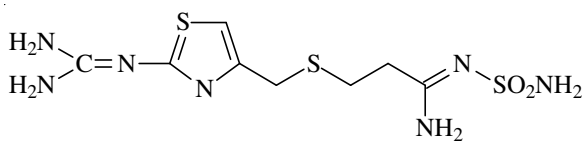

Fig. 1. Structure of famotidine

Several procedures have been reported in the literature for the determination of famotidine. These methods are spectrophotometry[1-3], liquid chromatography[4-6], fluorimetry[7], voltammetry[8], polarography[9] and potentiometry[10].

Ultraviolet-visible spectrophotometric method has been widely applied to the determination of compounds of pharmaceutical preparations. In general, this method is faster and cheaper than liquid chromatography and more precise than voltammetry. In this work, a new spectrophometric method for the assay of famotidine was developed, which was based on the charge-transfer reaction between famotidine and cresol red in ethanolic medium. In the proposed method, there are no complicated sample separation and extraction steps with satisfactory analytical results.

EXPERIMENTAL

A 722-N spectrophotometer (Shanghai precision and scientific instrument Co., Ltd., China) was used for the determination of absorbance.

Famotidine stock solution (1.2×10^{-2} mol L^{-1}) was prepared by dissolving 0.4052 g of famotidine in 100 mL volumetric flask and filling it up with ethanol. 1.2×10^{-3} mol L^{-1} famotidine standard working solution was obtained by diluting the stock solution with ethanol. 1.2×10^{-3} mol L^{-1} cresol red solution was prepared by dissolving 0.4589 g of cresol red and diluting the solution to 1000 mL with ethanol. The water used was distilled water and all the reagents were of analytical grade.

Procedure: A suitable amount of sample solution or standard famotidine working solution and 3.0 mL of cresol red solution were transferred into a 10 mL colorimetric tube. Then the solution was diluted to the mark with ethanol. After lying aside for 10 min at room temperature, the absorbance A of the complex solution was measured with 1.0 cm cell at 520 nm. The measurement was repeated in the absence of famotidine to obtain the absorbance A_0 of the reagent blank. The absorbance difference was defined as $\Delta A = (A_0 - A)$.

RESULTS AND DISCUSSION

Absorption spectra and reaction mechanism: Famotidine is nitrogenous compounds that act as n-donor, while cresol red is electron-deficient compounds that act as

π-acceptor. So famotidine reacts with cresol red to form charge-transfer complex of the *n*-π type. The absorption spectra of reagent cresol red and complex was shown in Fig. 2. From Fig. 2, it was found that the absorbance of the reagent decreased obviously in the presence of famotidine. The absorbance difference (ΔA) reached a maximum at 520 nm. Hence, 520 nm was selected for further studies.

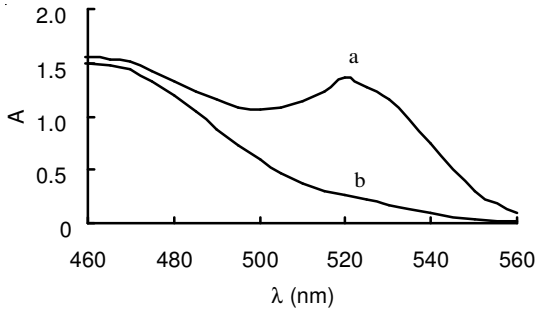

Fig. 2. Absorbance spectra: (a) cresol red (against ethanol), (b) cresol red + famotidine (against ethanol), 1.2×10^{-4} mol L^{-1} famotidine; 2.6×10^{-4} mol L^{-1} cresol red

The composition ratio of the complex was measured with equimolar continuous variation method (Job's method) and molar ratio method. The results were shown in Figs. 3 and 4, which indicated that the ratio of famotidine and cresol red in complex was 1:2. According to the above, the suggested structure of the charge-transfer complex was shown in Fig. 5.

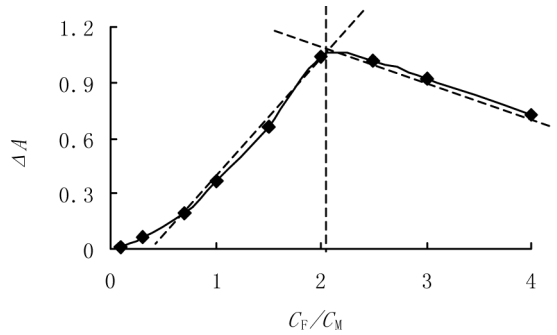

Fig. 3. Results of equimolar continuous variation method: $C_F + C_R = 2.4 \times 10^{-4}$ mol L^{-1}, C_F signifies the concentration of famotidine, C_R signifies the concentration of cresol red

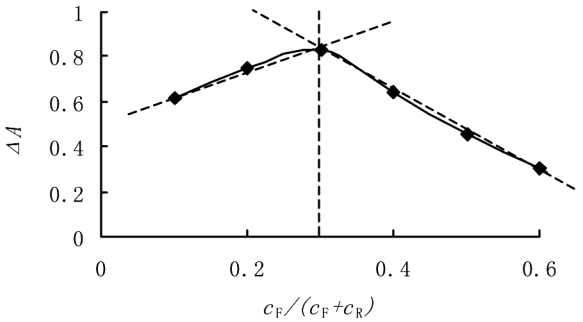

Fig. 4. Results of molar ratio method: $C_F = 1.2 \times 10^{-4}$ mol L^{-1}, $C_R = 1.2 \times 10^{-5}$-4.8×10^{-4} mol L^{-1}, C_F signifies the concentration of famotidine, C_R signifies the concentration of cresol red

Effect of temperature: The effect of temperature on ΔA in the range of 20-60 ºC was investigated and the results were shown in Fig. 6. It was seen that ΔA was almost constant at

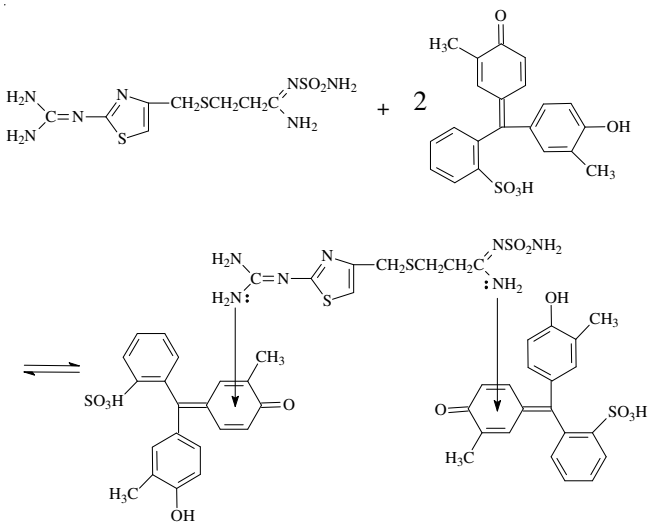

Fig. 5. Suggested structure of charge transfer complex of famotidine with cresol red

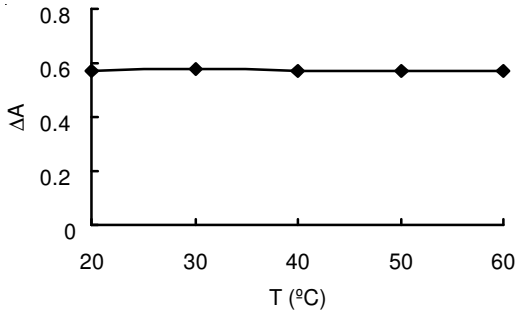

Fig. 6. Effect of temperature: 6.0×10^{-5} mol L^{-1} famotidine; 1.4×10^{-4} mol L^{-1} cresol red

20-60 ºC. For the reason of simple operation, room temperature was chosen as optimum temperature for further study.

Effect of reaction time: The effect of reaction time was studied. As shown in Fig. 7, famotidine reacted with cresol red within atmost 1 min at room temperature. The formed complex remained steady at least 3 h.

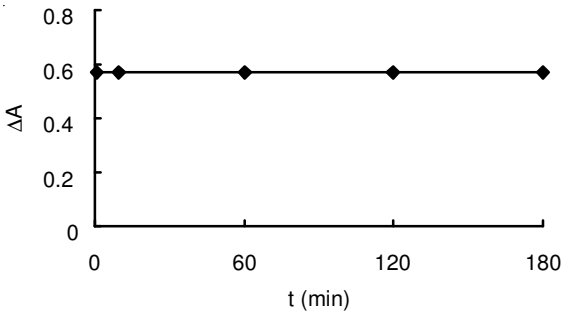

Fig. 7. Effect of reaction time: 6.0×10^{-5} mol L^{-1} famotidine; 1.4×10^{-4} mol L^{-1} cresol red

Effect of solvent: The effect of various solvents was investigated and the results were given in the Table-1. It was obvious from the data that ethanol was the best solvent with the maximum absorbance.

Working curve and detection limit: A series of standard famotidine solutions with different concentration were prepared. Under the chosen experimental conditions, ΔA of these solutions was measured. The working curve was drawn and shown in

TABLE-1
EFFECT OF SOLVENTS

Solvents	Water	Methanol	Ethanol	Acetone	Ethanol:acetone (1:1)	Ethanol:acetone (2:3)
A	0.035	0.584	0.903	0.178	0.624	0.471

TABLE-2
ANALYTICAL RESULTS OF FAMOTIDINE

Sample	Percentage of labeled value (w/%)	RSD (%)	Added (μg mL^{-1})	Recovered (μg mL^{-1})	Recovery (%)
Tablets	100.1	1.5	20.3	19.9	98.0
Capsules	100.5	1.1	20.3	20.2	99.5

Fig. 8. The results showed that Beer's law was obeyed in the concentration range of 2-61 μg mL^{-1} for famotidine. The linear regression equation was $\Delta A = 0.0163C + 0.4694$ with the regression coefficient $\gamma = 0.9995$. The reagent blank was determined 11 times and the detection limit of assay was 0.28 μg mL^{-1} by 3S/K method (S is the standard deviation of the reagent blank for 11 times determination, K is the slope of the working curve).

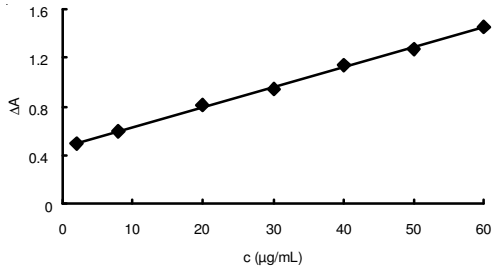

Fig. 8. Working curve: 1.2×10^{-4} mol L^{-1} cresol red

Application: The proposed method was applied to the determination of famotidine in commercial tablets and capsules. Five tablets and five capsules, which were obtained from local drug store, were weighed and grinded to divided powder and accurate weight of the powder containing 20 mg of famotidine were dissolved in 100 mL ethanol, respectively. The two solutions were then filtered off and analyzed by the proposed method, respectively. Seven replicate determinations were made. Satisfactory results were obtained for both dosage forms as shown in Table-2. Moreover, to check the validity of the proposed method, the standard addition method was applied by adding famotidine to the previously analyzed tablets or capsules. The recovery of each dosage forms was calculated and was also shown in Table-2.

Conclusion

This paper demonstrated that charge-transfer reactions can be utilized as a useful method for the spectrophotometric determination of famotidine. The proposed method has the advantages of being simple, cheap, accurate, rapid and requires minimum equipments and chemicals. These advantages encourage the application of the proposed method in routine quality control of the investigated famotidine in industrial laboratories.

ACKNOWLEDGEMENTS

This work is supported by Nature Science Research Project of Huaihai Institute of Technology, China (No. 2010150014).

REFERENCES

1. I.A. Darwish, S.A. Hussein, A.M. Mahmoud and A.I. Hassan, *J. Spectrochim. Acta A*, **69**, 33 (2008).
2. K.M. Kelani, A.M. Aziz, M.A. Hegazy and L.A. Fattah, *J. Spectr. Lett*., **35**, 543 (2002).
3. A.S. Amin, S.A. Shama, I.S. Ahmed and E.A. Gouda, *J. Anal. Lett*., **35**, 1851 (2002).
4. A. Zarghi, A. Shafaati, S.M. Foroutan and A. Khoddamc, *J. Pharmaceut. Biomed. Anal*., **39**, 677 (2005).
5. A.N. Campbell and J. Sherma, *J. Liq. Chromatogr. Rel. Technol*., **28**, 2719 (2003).
6. D.A.I. Ashiru, R. Patel and A.W. Basit, *J. Chromatogr. B*, **860**, 235 (2007).
7. M.I. Walash, A. El-Brashy, N. El-Enany and M.E. Kamel, *J. Fluorec.*, **19**, 333 (2009).
8. S. Skrzypek, W. Ciesielski, A. Sokolowski, S. Yilmaz and D. Kazmierczak, *Talanta*, **66**, 1146 (2005).
9. J.A. Squella, G. Valencia, I. Lemus and L.J. Nunez-Vogara, *J. Assoc. Off. Anal. Chem*, **72**, 549 (1989).
10. M.M. Ayad, A. Shalaby, H.E. Abdellatef and H.M. Elsaid, *J. Pharmaceut. Biomed. Anal*., **29**, 247 (2002).