A high sensitive colorimetric assay for the determination of dopamine hydrochloride in pharmaceutical preparations Using charge transfer complex reaction.

Abdul Barry Mahdi Mahood and Mohammed Jassim Hamzah.
Pharmaceutical Chemistry Department, Pharmacy College, Kerbala University.

(NJC)

(Recevied on 19/5/2009) (Accepted for publication 12/1/2010)

Abstract

A simple , rapid and sensitive spectrophotometric method for the determination of trace amounts of dopamine hydrochloride in aqueous solution is described. The method is based on a reaction between dopamine hydrochloride with the mixture of Fe^{+3} and hexacynoferrate(III) ions to form an intense Prussian blue color complex that has a maximum absorption at 710nm with a molar absorptivity of $2.138x10^{4}$l.mole^{-1}. cm^{-1} and a sandell sensitivity of $8.862x10^{-6}$µg.cm^{-2}. Under optimum reaction conditions the absorbance of the Prussian blue color complex were found to increase linearly with increase in concentration of dopamine hydrochloride in the range (0.4-12ppm) with a relative standard deviation of 0.138-0.350% and a relative error of -1.983 to 2.9%. The proposed method was successfully applied for the determination of the selected drug in pharmaceutical preparations with very good recoveries of 98.02- 103.02%.

الخلاصة

يتضمن البحث الحالي تطويرطريقة طيفية سريعة وذات حساسية عالية لتقدير عقار الدوباامين هايدروكلورايد في المحاليل

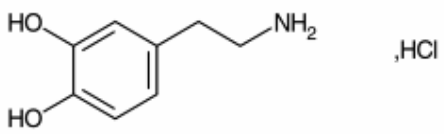
المائية تعتمد الطريقة المطورة على تفاعل العقار مع مزيج من ايونات الحديد (III) و سداسي سيانيد الحديد الثلاثي ليكون معقد ذات

لون ازرق بروسياني الذي يمتلك اعلى امتصاص عند طول موجي λ_{max} = 710 نانوميتر. بلغت قيمة معامل الامتصاص المولاري $2.138x10^{4}$ لتر.مول$^{-1}$.سم$^{-1}$ ودلالة ساندل $8.862x10^{-6}$ مايكروغرام.سم$^{-2}$. تم تثبيت ظروف المثلى للتفاعل للحصول على اعلى شدة امتصاص للمعقد الازرق البروسياني وباستخدام الظروف المثبتة وجد ان امتصاصية المعقد الازرق البروسياني تزداد خطيا ،

بازدياد تركيز العقار ضمن المدى(0.4-12) جزء لكل جزء بالمليون وانحراف قياسي نسبي مقدارة 0.138-0.350% مع خطا نسبي مقدارة (1.983-) – 2.9% . تم تطبيق الطريقة المطورة بنجاح على المستحضرات الصيدلانية الحاوية على عقار الدوباامين هايدروكلورايد باستعادية 98.02 – 103.02 %.

Introduction

Dopamine hydrochloride contains not less than 98.0 percent and not more than
the equivalent of 102.0 percent of 4-(2-aminoethyl)benzene-1,2-diol hydrochloride,
and[1] it used as sympathomimetic agent,with following formula.



Literature survey for dopamine hydrochloride revealed several methods for it is determination such as spectrophotometric[2-3], flow injection[4-6], fluorimetric[7], sensor[8], voltammetric[9-10] , and chromatographic[11-12].
This article describes the development of a simple spectrophotometric method for the assay of dopamine hydrochloride in pure and dosage forms, based on the reduction of $Fe^{(+3)}$ ion by the drug and subsequent interaction of $Fe^{(+2)}$ ion with hexacyno Ferrate(III) to form a Prussian blue color complex that has a maximum absorption at λ_{max}=710nm.The method was applied successfully to determination of dopamine hydrochloride in drug.

Experimental

Apparatus:

All spectral and absorbance measurement were carried out on a shimadzu
UV-vis(200-900nm) 1800 digital double beam recording spectrophotometer using 1-cm quarts cells.

Reagents:

All chemicals used were of analytical reagent grade unless otherwise state ,dopamine hydrochloride Standard powder was provided from Cipla India ,Mumbai,India.
Adrenaline injection ampoule was provided from miser company – Egypt.

- Dopamine hydrochloride stock solution(1000 ppm):

A quantity of 0.1 gm dopamine hydrochloride was dissolved in 100ml of distilled water.

- Ferric chloride (0.03M):

Prepared by dissolving 0.49gm of $FeCl_3$ in 1ml of concentrated HCl and made up to 100ml volumetric flask with distilled water.

- Potissum hexacynoferrate(III) (0.0081M):

Prepared by dissolving 0.27gm of $K_3Fe(CN)_6$ in 100ml of distilled water.

Recommended Procedure

In to a series of 25ml volumetric flasks, Increasing volumes of (100ppm) dopamine hydrochloride solution in the range of calibration curve(0.4-12ppm) were transfer , 0.5ml (0.03M) of $FeCl_3$ was added and shake well. Followed by 0.5ml (0.0081M) of $K_3Fe(CN)_6$,dilute the solution to the mark with distilled water, and allow the reaction to stand For 15min.Measure the absorbance at 710nm against a reagent blank prepared in the same way but containing no dopamine. The color of the Prussian Blue complex is stable for 30min after that a blue precipitate was observed.

Procedure for pharmaceutical preparations:

- **Dopamine hydrochloride ampoule(200mg/5ml):**

The content of One ampoule of dopamine hydrochloride was diluted to 100ml in a volumetric flask with

distilled water . Then 5ml from the above solution was diluted to 100ml in a volumetric flask with distilled water to obtain (100ppm). This solution is used for the determination of the drug by recommended procedure.

Results and discussion

Absorption spectra:

When a diluted aqueous solution of dopamine hydrochloride is treated with Fe^{+3} ion in the presence of potassium hexacynoferrate(III) forms a prussian blue color complex that has a maximum absorption at λ_{max} = 710nm (Fig.1).The absorbance of the Prussian blue color complex depends very much on the reaction Conditions, therefore it is very important to optimize the reaction conditions.

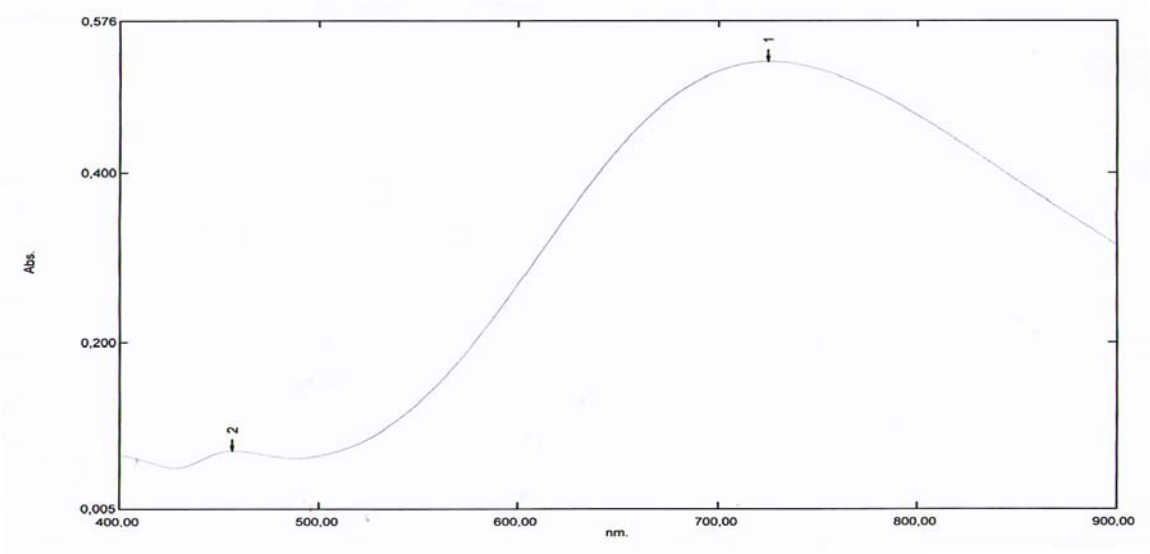


Fig.1: Absorption spectrum of the complex .

Optimization of the Conditions

The effect of various parameters on the absorbance intensity of the complex
formed were studied and the reaction conditions were optimized.

Effect of $FeCl_3$ concentration:

The effect of different concentration of Fe^{+3} ion was investigate in the range (0.1-2.5ml) 0.03M ,0.5ml(0.03M) of $FeCl_3$ gave the highest absorbance as shown in Fig.2 , therefore it is chosen for further work.

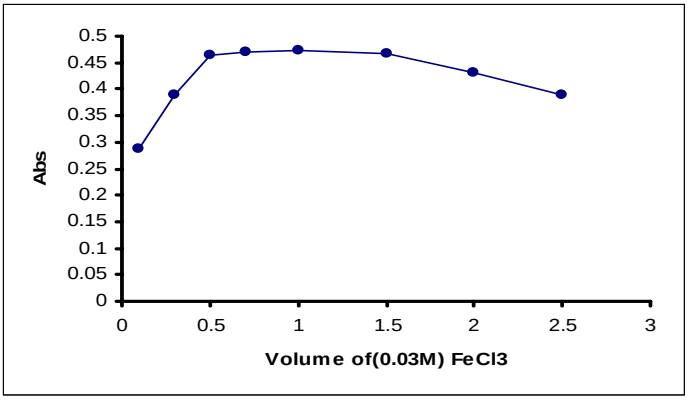


Fig.2: Effect of $FeCl_3$ concentration.

Effect of $K_3Fe(CN)_6$ concentration:

The effect of $K_3Fe(CN)_6$ concentration was also studied in the range (0.0000324-0.000972M).The absorbance increased with increasing concentration up to 0.000162M ,above which is stable as shown in Fig.3.

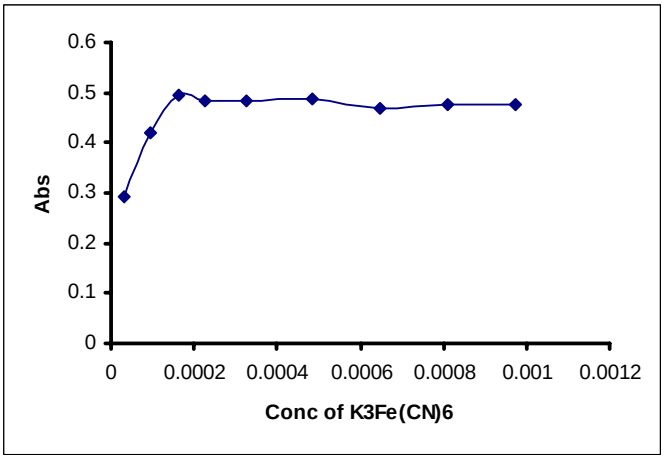


Fig.3: Effect of $K_3Fe(CN)_6$ concentration.

Effect of order of addition:

After fixing all other parameters, a few other experiment were performed to ascertain the influence of the order of addition of reactants. The order, drug : Fe^{+3} ion : ferric cyanide , after full color development gave a maximum absorbance and hence the same order was followed throughout the investigation as shown in table .1.

Table.1: Effect of order of addition for reactants

Arrangement	Absorbance
1- drug+Fe^{+3} +$K_3Fe(CN)_6$	0.478
2- drug + $K_3Fe(CN)_6$ + Fe^{+3}	0.395
3- Fe^{+3}+ $K_3Fe(CN)_6$ + drug	0.410

Effect of temperature:

Table (2) shows, neither high temperature of 50^0C which caused precipitation, nor the ice bath of 5^0C which has reduced the absorbance. The optimum was found to be 25^0C .

Table.2: Effect of temperature

Temperature (^{0}C)	Absorbance
5	0.346
25	0.483
50	Blue particles precipitate

Effect of reaction time and stability:

Fig (4) shows that the reaction between dopamine hydrochloride with Fe^{+3} and $K_3Fe(CN)_6$ has reached the optimum after 10-15 min .Therefore measurement were taken after 15 min.

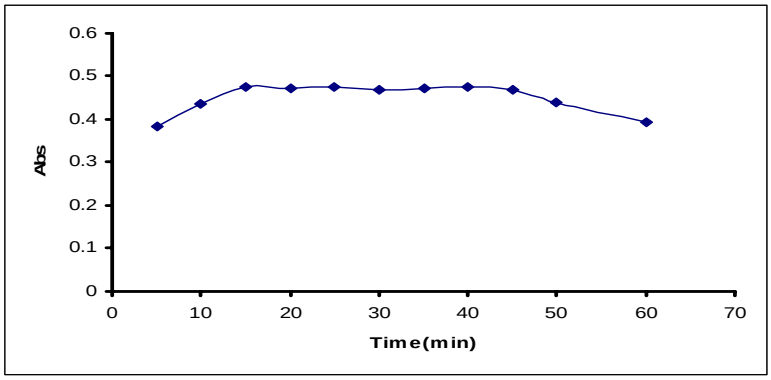


Fig.4: Effect of reaction time

The Calibration Curve

The conditions described under the procedure, a liner calibration curve of dopamine hydrochloride is obtained(Fig5),which shows that Beer's law is obeyed over the concentration range 0.4-12 of dopamine hydrochloride with a correlation coefficient of 0.9993 and intercept of 0.0285.The molar absorptivity of the Prussian blue color complex was found to be $2.138x10^4 L.mole^{-1}.cm^{-1}$ with reference to dopamine hydrochloride and sandell index of $8.862x10^{-6}$ µg.cm^{-2} with detection limit of 0.02 ppm.

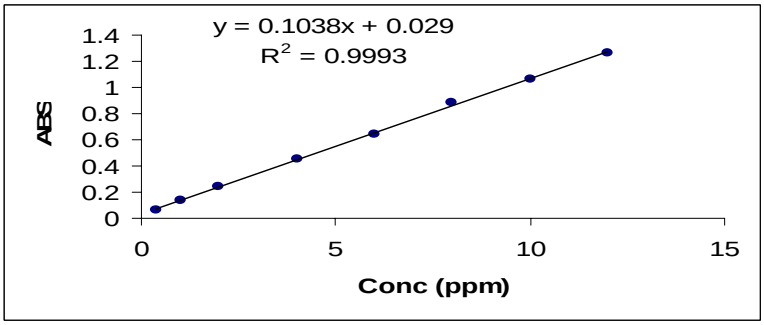


Fig. 5: Calibration curve of dopamine hydrochloride.

Accuracy and Precision

In order to establish the validity and accuracy of the proposed method for the determination of pure drug solutions containing three different concentrations of dopamine hydrochloride were prepared and analyzed in five replicates. The analytical results obtained from this study are summarized in table.3.

Table.3: Accuracy and precision of the proposed method

Concentration of dopamine hydrochloride (ppm)		Recovery*%	R.S.D*%	Error*%
Taken	Found			
4	4.070	101.75	0.350	1.75
6	5.881	98.02	0.207	-1.98
8	8.232	102.90	0.138	2.9

*five replicated

Analytical Application

One ampoule containing dopamine hydrochloride(200mg/5ml) has been analyzed using the calibration curve in the range (0.4-12ppm) giving a very good accuracy and precision as shown in table.4.

Table.4: Application of the proposed method for the determination of dopamine hydrochloride in pharmaceutical preparations

Drug sample	Amount of adrenaline (ppm)		Recovery*%	R.S.D* %	Error*%
	present	found			
Dopamine hydrochloride (miser. co) Egypt	4	4.051	101.27	0.620	1.27
	8	8.241	103.02	0.149	3.01

*five replicated.

Conclusions

On the basis of obtained data, we found a new analytical form and developed a new methodology for determining micro amounts of dopamine hydrochloride using charge transfer complex. The technique has good metrological characteristics, high sensitivity, and is simple in use.

References

1- "**British pharmacopeia** ",vol.1,Horns,London,2000 ,p.1042-1043.

2- N.R, Reddy, G. Sreedevi , K. Prabhavathi and I.E. Chakravathy, ***Anal. Chem***,2005,**60**,252.

3- T.Madrakian , A.Afkhami and M.Mohammadnejad , ***J.Braz.Chem.Soc***, 2006, **17**, 1259.

4- H.Yao , Y.Y.Sun , J.Cheng and L.Huang , ***J Of Bioluminescenc and Chemiluminescence***, 2006,**21**,112.

5- K.Loay , A.M.AL-Abachi and M.H.Al-Qaissy , ***Anal Chimi. Acta***, 2005, **538**, 331.

6- Z.E.Seckin and M.Volkan , ***Anal Chimi. Acta,*** 2005, **547**, 104.

7- H.Y.Wang , Q.S.Hui , L.X.Xu , J.G.Jiang and Y.Sun , ***Anal Chimi. Acta*** , 2003, **497**, 93.

8- R.K.Shervedani , M.Bagherzadeh ana S.A.Mozaffari , ***Sensors and Actuators***, 2006, **115**, 614.

9- A.Rouhollahi , R.Rajabzadeh and J.Ghasemi , ***Microchimica Acta***, 2007, **157**, 139.

10- W.L.Yeh , Y.R.Kuo and S.H.Cheng , ***Electrochemistry Communications***, 2008, **10**, 66.

11- T.Yoshitake , J.Kehr , H.Nohta and M.Yamaguchi , ***Biomedical Chromatography***, 2005, **20**, 267.

12- T.Yoshitake , J.Kehr , K.Fujino , H.Nohta and M.Yamaguchi , ***J Of Chromatography,*** 2004, **807**, 177.