IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, May 2024

Spectrophotometric Determination of an Antimalarial Drug Mefloquine in Bulk and Pharmaceutical Formulations by Iron Phenanthroline Method

Ritika Manoj Makhijani and Mahalaxmi Murugan
Department of Chemistry
VES College of Arts, Science and Commerce, Chembur, Mumbai, India

Abstract: *A spectrophotometric method have been developed for determination of an antimalarial drug Mefloquine. The developed method is new, simple, sensitive, precise, accurate and reproducible. At 510 nm, absorbance of orange coloured chromogen is measured, which is produced by oxidation of drug with 1, 10-phenanthroline. Beer's Law is obeyed in the concentration range of*
4.0 – 28.0 µg/ml for the developed method. The molar absorptivity and sandell's sensivity are found to be 2269.87 L mol-1cm-1 and 0.166 µg/cm2 respectively. Various parameters affecting the stability and development of colour was thoroughly studied and optimized. The method has been successfully applied for determination of mefloquine in both pure and dosage forms. The result obtained by the developed method is found to be in good agreement when compared with the standard methods.

Keywords: Mefloquine hydrochloride, spectrophotometry, 1,10- phenanthroline

I. INTRODUCTION

Mefloquine hydrochloride (Fig-1) is the hydrochloride salt of 4-quinolinemethanolα-2- piperidinyl-2,8-bis(trifluoromethyl), hydrochloride. In 1970s, United States Army developed Mefloquine, and in mid 1980s it came into use. 1980s[1-3]. In the World Health Organization's List of Essential Medicines, mefloquine is considered as the safest and most effective medicines needed in a health system[4] . Mefloquine is an antimalarial drug, which is found to be effective against all forms of malaria, and in endemic areas this is the main drug recommended for malaria chemoprophylaxis.[5,6] Since malaria is the world's most widespread parasitic infection, ranking among the major health and developmental challenges for poor countries, Mefloquine plays an important role for the control, treatment, and prevention of this disease worldwide.[7]

As per Literature , an HPLC method for the estimation of potentially counterfeit chloroquine, quinine, and mefloquine tablets was reported.[8] Some papers described the determination of MQ in biologicalfluids, such as blood, plasma, and urine, by HPLC using UV detection.[9–11] An HPLC method for the quantitative enantioselective analysis of mefloquine stereoisomers was also described.[12] But no simple, sensitive and precise spectrophotometric method is yet reported for this drug in any official literature. So in the present study, a specific, precise, accurate and validated spectrophotometric method has been developed for the estimation of mefloquine hydrochloride in bulk and tablet dosage form.

II. MATERIALS AND METHODS

Instrumentation

All measurements of absorption spectra were made on model LABMAN UV-VIS Spectrophotometer using quartz cells of 1cm path length and wavelength range 320-1000nm was used for absorbance measurement. All chemicals employed in the present study were of analytical grade and purchased from Loba Chemie. Double distilled water prepared by distilling water in a Borosil glass apparatus containing alkaline Potassium Permanganate was used for preparation of standard solution as well as for all experimental work.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, May 2024

Preparation of Standard solution of drug

An accurately weighed 5 mg of mefloquine dissolved in methanol .The final volume is adjusted with methanol to 100ml in standard flask.

Preparation of Reagents

0.005M Fe (III) - Dissolve 0.241g of anhydrous ferric ammonium sulphate in 100cm^3 of double distilled water, 0.05M 1,10-phenanthroline - Dissolve 0.991g of the reagent in 100 cm^3 of alcohol, 0.02M o-phosphoric acid - Dilute 0.15cm^3 of laboratory reagent (AR Grade) of o- phosphoric acid to 100 cm^3 with distilled water.

Experimental Procedure

Different portions (1.0- 7.0ml, 100 µg/ml) of Standard mefloquine solution is delivered into a series of 25mL standard flask and then 1.0 mL of 5.0 x10^{-3} M of Fe (III) solution, 1.0 mL of 5.0x10^{-2} M 1,10 -phenanthroline are added successively. The total volume in each tube is brought to 20 ml with distilled water. The flasks are kept on a boiling water bath for 40 min. The tubes are removed and cooled to room temperature. 1.0 ml of 2.0 x10^{-2} M of o- phosphoric acid is added and volume in each flask is made up to the mark with distilled water. The absorbance of the colored complex solution is measured after 5 min against a reagent blank prepared similarly except drug and maximum absorbance is found to be at 510 nm (Fig-2). The amount of the mefloquine drug is computed from the appropriate calibration graph (Fig-3). Effect of concentration of H3PO4, 1,10Phenanthroline and time of digestion on the absorbance are studied by keeping other parameter constant.

Analysis of Pharmaceutical Sample

Analysis of pharmaceutical sample Tablets powdered equivalent to 5 mg of the drug is weighed accurately and transferred into 100 ml beaker and shaken with 50 ml methanol by following standard method. The standard solution is filtered into 100ml standard flask and volume is adjusted with methanol. Suitable aliquots of this solution used for the determination of mefloquine contents by procedure describe earlier.

Effect of Concentration of H3PO4 on Color Development

After addition of 3.0cm^3 of of H3PO4 absorbance remains constant. Hence 4cm^3 of H3PO4 is selected for the colour development and further experimental studies. (Fig-4)

Effect of Concentration of 1,10-Phenanthroline

After addition of 3.0cm^3 of 1,10phennthroline absorbance remains constant. Hence 4cm^3 of H3PO4 is selected for the development of colour and further experimental studies. (Fig-5)

Effect of Heating Time on Absorbance

For colour development 60 minutes are sufficient and hence 60 minutes time is selected for further experimental studies. (Fig-6)

III. RESULTS AND DISCUSSION

In order to test whether the coloured product formed in this method adhere to Beer's Law, the absorbance at maximum wavelength of series of seven concentrations are plotted against concentration of drug in µg/cm^3. Beer's Law is obeyed within the limits 4.0 to 28.0 µg/ml of mefloquine, Molar absorptivity and sandell sensitivityare found to be 2269.87 L $mol^{-1}cm^{-1}$ and 0.166 µg/cm^2 respectively. Regression analysis of Beer's Law plots at λmax reveals a good correlation. The graph show negligible intercept and described by regression equation y = 0.0051x + 0.0027. where Y is the absorbance of 1 cm layer, b is the slope, a is the intercept and C is the concentration of the measured solution in µg/mL) The high molar absorptivity of resulting coloured complex indicates the high sensitivity of method.(Table -1) Mefloquine is analyesed from the proposed method and the result obtained are comparable with standard method (Table- 2).

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, May 2024

Principle of developed method

Ferric salt when reacts with the Mefloquine it gets converted into ferrous salt upon oxidation and can be easily identified by the usual reagent 1,10-phenanthroline. Coloured complex of Fe (II), is well known as ferroin and is the reduction product. [13-15]The colored product of the reaction is given in Figure 7.

Regression parameters, Optical characteristics Precision and Accuracy of the proposed method are shown in Table -1

Determination of Pharmaceutical Formulations of Metformin by our proposed method and reference method is shown in Table -2

IV. CONCLUSION

The developed method is simple, sensitive, accurate and reproducible. This method can be successfully applied for the analysis of pharmaceutical formulations in any laboratory.

ACKNOWLEDGEMENTS

The authors gratefully acknowledged the use of central instrumentation facilities at V.E.S College of Arts Science &Commerce funded by FIST-DST.
(Ministry of Science & Technology, Department of Science & Technology) The Authors are also thankful to Principal VES College of Arts Science and commerce for providing all thre necessary facilities to complete the above research project.

Fig. 1 Structure of Mefloquine

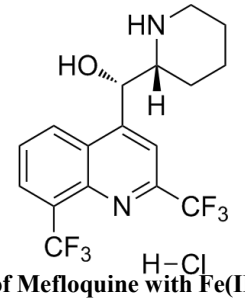
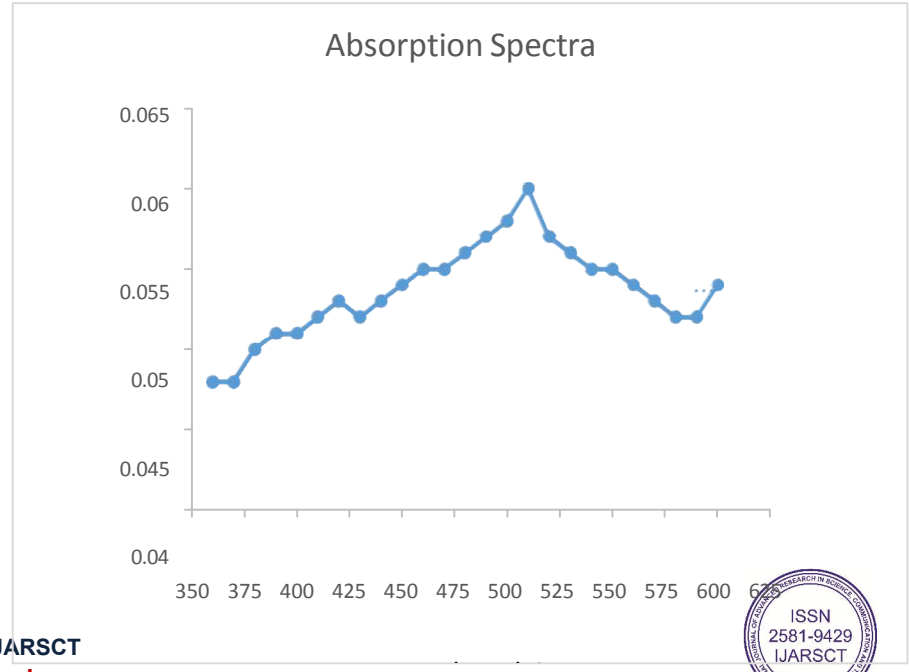


Fig.-2: Absorption spectra of Mefloquine with Fe(III)/1,10-Phenanthroline



IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, May 2024

Fig.-3: Calibration curve of Mefloquine with Fe (III)/1,10-Phenanthroline

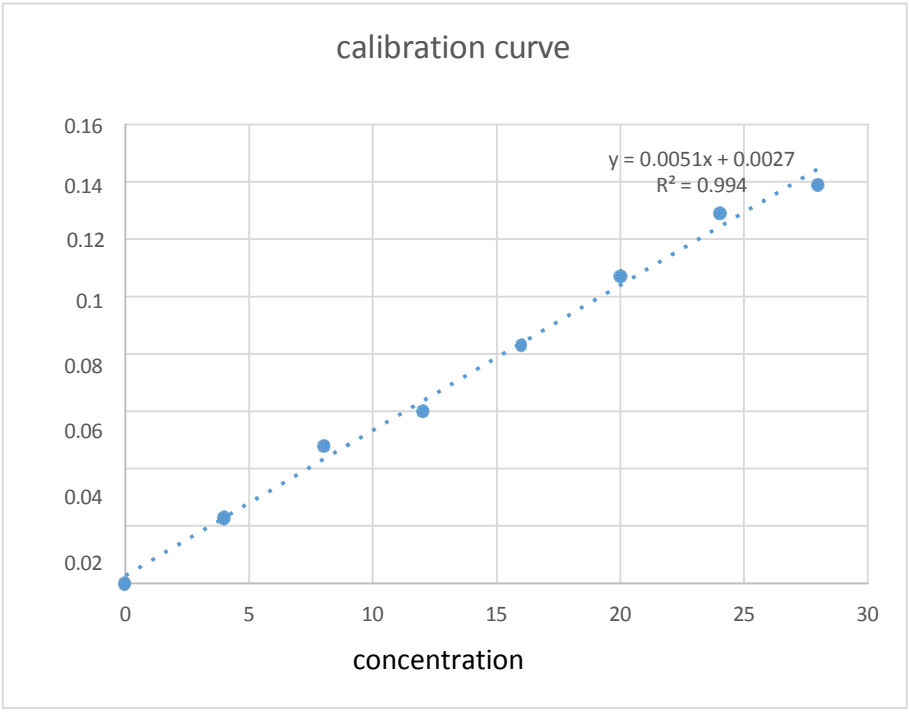
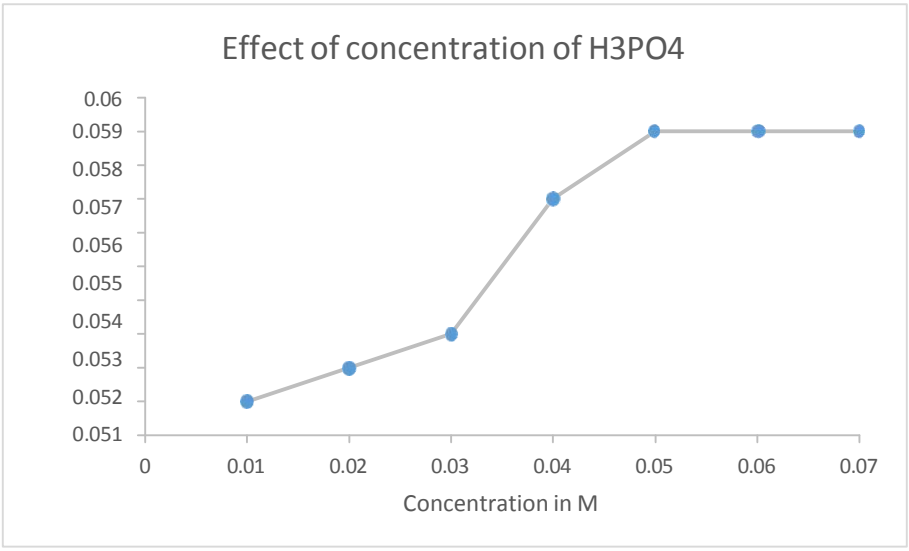


Fig.4 Effect of concentration of H3PO4 on colour development



IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, May 2024

Fig.5 Effect of concentration of 1,10-Phenanthroline on absorbance of developed system

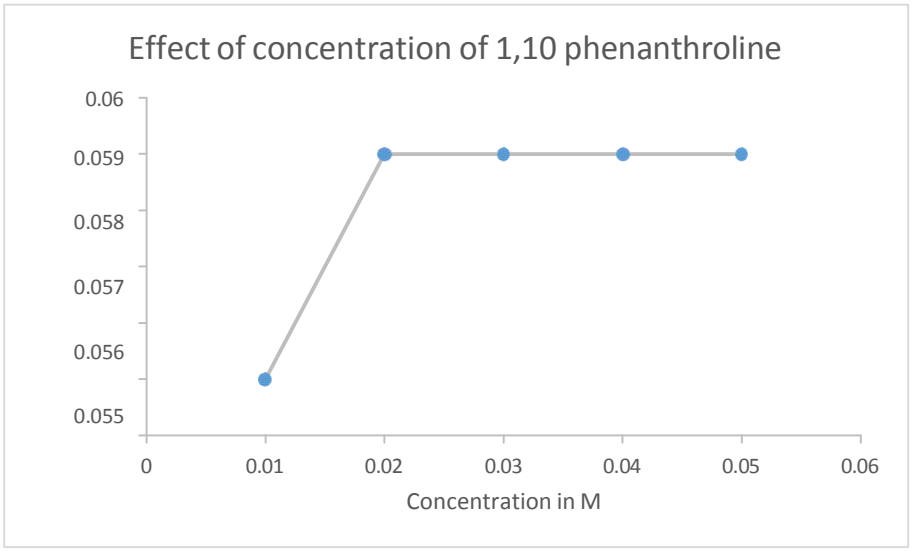
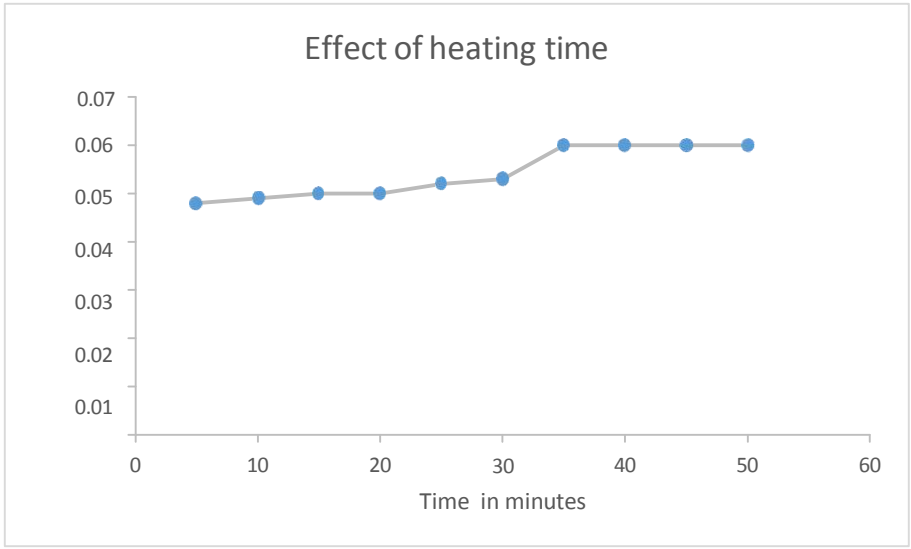


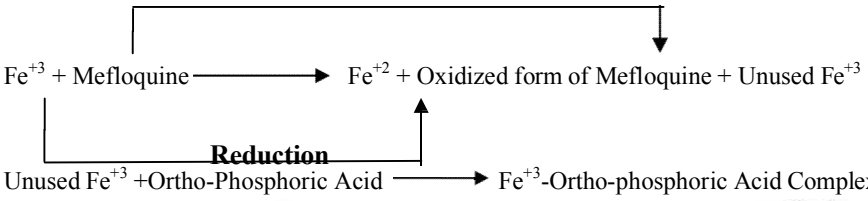
Fig.6 Effect of heating time on absorbance



IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, May 2024

Fig.7 Coloured development reaction

Oxidation



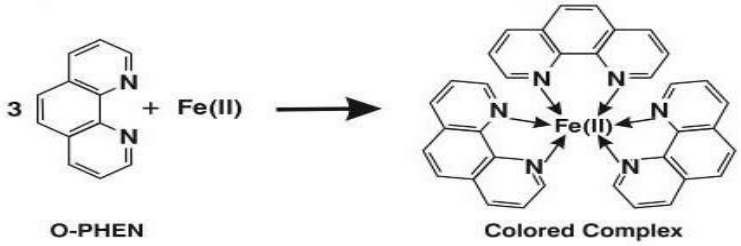


Table-1 Regression parameters, Optical characteristics Precision and Accuracy of the proposed method.

Parameter	**Method**
λmax Maximum Wavelength	510 nm
Beer's Law Limits µg/cm^3	4-28
Sandell's Sensitivity (µg/cm^2 /0.0001 Absorbance)	0.166
Molar Absorptivity Lt.mole^{-1}.cm^{-1}	2269.8
Slope (b)[a]	0.0051
Intercept (a)[a]	0.0027
S.D on intercept(S_a)	0.0089
Correlation Coefficient (r)	0.994
Standard Deviation (S)	0.0369
%Relative Standard Deviation	39.126
Limit of Detection (LOD)µg/cm^3	5.762
Limit of Quantification (LOQ)µg/cm^3	17.462

[a]Regression equation is given as Y= a+bC , Where Y is the absorbance and C is the concentration in µg/cm^3 and b is %Relative standard deviation which is calculated for ten determinations.

Table-2 Determination of Pharmaceutical Formulations of Metformin

Drug	Manufacturing company	Labelled amount(mg)	*Amount found by Proposed Method	*Amount found by Reference Method
Mefloquine tablet	Abbott Healthcare Pvt. Ltd.	500	499.69	499.87

REFERENCES

[1]. Croft, AM (2007). "A lesson learnt: the rise and fall of Lariam and Halfan". J R Soc Med. 100 (4): 170–4. doi:10.1258/jrsm.100.4.170. PMC 1847738. PMID 17404338.

[2]. Ravina, Enrique (2011). The evolution of drug discovery : from traditional medicines to modern drugs (1. Aufl. ed.). Weinheim: Wiley-VCH. p. 136. ISBN 9783527326693.

[3]. Jeremy Farrar; Peter J. Hotez; Thomas Junghanss (2013). Manson's tropical diseases(23rd ed.). Oxford: Elsevier/Saunders. p. 569. ISBN 9780702053061.

[4]. World Health Organization (2019). World Health Organization model list of essential medicines: 21st list 2019. Geneva: World Health Organization. hdl:10665/325771. WHO/MVP/EMP/IAU/2019.06. License: CC BY-NC-SA 3.0 IGO.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, May 2024

[5]. WHO (2006) Guidelines for the Treatment of Malaria, Geneva, Switzerland
[6]. Senn, N., D´Acremont, V., Landry, P., & Genton, B. (2007) Am. J. Trop. Med. Hyg. 77, 1010–1014
[7]. Guerin,P.J., Olliaro, P., Norsten, F., Druilhe,P.,Laxminarayan, R., Binka, F., Kilama, W.L., Ford, N., & White, N.J. (2002) Lancet Infect. Dis. 2, 564–573
[8]. Gaudiano, M.C., Antoniella, E., Bertocchi, P., & Valvo, L. (2006) J. Pharm. Biomed. Anal. 42, 132–135
[9]. Grindel, J.M., Tilton, P.F., & Shaffer, R.D. (1977) J. Pharm. Sci. 66, 834–837
[10]. Taylor, R.B., Reid, R.G., Behrens, R.H., & Kanfer, I. (1992) J. Pharm. Biomed. Anal. 10, 867–871
[11]. Green, M.D., Bergqvist, Y., Mount, D.L., Corbett, S., & D´Souza, M.J. (1999) J. Chromatogr. B 727, 159–165
[12]. Qiu, Y., Kitamura, S., & Guillory, J.K. (1992) Pharm. Res. 9, 1640–1643
[13]. Barhate V.D., Karad M.D., Development of spectrophotometric determination of an antidiabetic drug saroglitazr bulk and pharmaceutical formulations using 1,10 phenanthroline, International Journal of Pharmacy, Biology and Chemistry,4(3) , 548-553, (2015)
[14]. Barhate V.D., Parastekar V., Spectrophotometric determination of mephedrone in a bulk form, Int J Curr PharmRes., 7(3), 51-55, (2015)
[15]. Dina El Sherbiny, Dalia El wasseef, Mohamaed El-Ghaffar., Saadia El-Ashry, Spectrophotometric methods for determination of Ritrodrine in bulk and in pharmaceutical dosage form, J. Food Anal, 16(2), 26-35, (2008)