New Technique for Estimation of Ciprofloxacin hydrochloride by using UV-VIS Spectrophotometer

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Abstract:

New, basic and quick method showing ultraviolet - visible spectroscopy was produced and approved for the estimation of ciprofloxacin in immaculate shape and in separate details. The occupants of business tablets planning did not meddle with the test. The satisfactory medication solvency finish and most extreme test affectability was found as potassium ciprofloxacin salt, the potassium ciprofloxacin salt show greatest absorbance at (335 nm) in absorbance spectrum, and the calibration curve was found to be linear in the stated concentration range of (2-10 □g.mL-1) and (Y= 0.0784X + 0.0547) as line equation, (R2=0.9985) as Correlation Coefficient, (+0.054714) as Intercept, (0.078363) as Slope, (SEE=0.009558) as Standard Error of Estimate, (0.999999885) as Chi-Square(The goodness of fit between observed values and those expected theoretically), (RSD=0.019475788) as Relative Standard Deviation, and (R2 =0.99854471) as Multiple Correlation Coefficient.

Key words: Determination, UV-VIS spectroscopy, ciprofloxacin (CIP), potassium ciprofloxacin salt (K- CIP)..

مفاتيح الكلمات: التقدير ٬ ملح سيبروفلوكساسين البوتاسيوم ، مطيافية الاشعة فوق البنفسجية.

الخلاصة:

تـم تطـوير طريقـة طيفيـة جديـدة وبسـيطة وسـريعة لتقـدير سيبروفلوكساسـين بصـورتهالنقية وفـي المستحضـراتالدوائية المختلفـة،والتحقق مـن صـحتها. وإن الاضـافات الموجـودة فـي مستحضـرات الدوائيـة لا تتـداخل معـه عنـد اجـراء تقـدير سيبروفلوكساسـين. تعتمـد الطريقـة علـى ذوبـان سيبروفلوكساسـين التـام وبحساسـية الفحـص القصـوى علـى شـكل ملـح سيبروفلوكساسـين البوتاسيوم، وقد تم قياس اعظم امتصاصية لملح سيبروفلوكساسين البوتاسيومعند طول موجي (335 نـانومتر)، واعتمد منحنى المعايرة لمدى من التراكيز (2-10 ميكروغراملكل مـل)، ومعادلـة منحنى المعايرة (Y = 0.0547 + 0.0784X)، ومعامل ارتباط (0.9985 = R2)، والميل (0.078363)، والتقاطع (+0.054714)، ومساحة تشي (0.999999885)، والخطأ القياسي للتقدير (0.009558) ، الانحراف القياسي النسبي(0.019475788)، ومعامل الارتباط المتعدد (0.99854471 R2) .

Introduction:

Ciprofloxacin is a broad-spectrum Fluoro-quinolone antibiotic [1]. It is dynamic against both microscopic organisms of Gram-positive and Gram-negative[2], having just direct movement against gram positive microscopic organisms, for example, Streptococcus pneumonia and Enterococcus faecalis, and especially against gram negative microorganisms including Salmonella, Shigella, Neisseria and Pseudomonas aeruginosa species[3,4]; Ciprofloxacin as other fluoro-quinolones, as shown in (Figure 1); Contains at position 7 a piperazine group of the 4-quinolone nucleus.
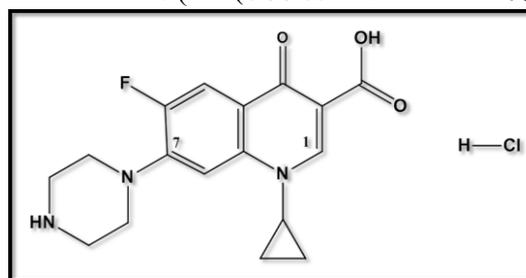
Figure 1: Chemical structure of ciprofloxacin

It is quickly catching up with an opportunity to more extreme plasma focus (Tmax) of 1-2h and showcases straight pharmacokinetics over the dose go studied from (250 to 750 mg), with a half-life (t1/2) after the single or rehashed

organization of around (3-5 h). At least 70% of the oral measurement is discharged unaltered in the urine. Plasma protein authoritative of ciprofloxacin is around 30% [5-7].

Analytical methods are required to characterize drug substances and product's composition during all periods of pharmaceutical advancement.

Change of methods to achieve the last objective of guaranteeing the nature of medication substances and items must be actualized in conjunction with a comprehension of the synthetic conduct and physicochemical properties of the medicinal substance. These determinations require exceptionally complex instruments and methods such as High-performance liquid chromatography, Gas Chromatography and Spectrophotometer…. Etc..

Broad writing, study uncovers that several analytical techniques have been accounted for the estimation of ciprofloxacin hydrochloride in pharmaceutical dose shape which incorporates spectrophotometric strategies, HPLC and RP-HPLC.

It is fundamental to decide ciprofloxacin with the end goal of pharmaceutical quality control. Most of the indicative techniques for the affirmation of ciprofloxacin utilize HPLC[8,9], it is moreover the official method in United States Pharmacopeia and Brasileria Pharmacopeia[10,11]. Different strategies have been accounted for the assurance of ciprofloxacin utilizing systems, for example visible spectrophotometer [12,13].

Turbid-metric technique for the estimation of ciprofloxacin hydrochloride in ophthalmic solutions [14]; FTIR spectroscopy: A tool for quantitative analysis of ciprofloxacin in tablets [15],the method involves the extraction of the active ingredient with methanol followed by phosphate buffer pH 6.0; An analysis of ciprofloxacin by a simple HPLC method by employing reversed-phase chromatography using an isocratic mobile phase of acetonitrile (2%) and acetic acid aqueous solution (16:84, v/v). Umbelliferon was used as an internal standard [16].

The estimation of ciprofloxacin hydrochloride was accomplished by using the zero /0th, first, and second order procedure amounts metriced at 264, 273 and 273 nm respectively [17] ,

The purpose of the current study is to suggest an accurate, precise, simple, sensitive and directly spectrophotometric technique for estimation of ciprofloxacin hydrochloride in tablet dosage forms from different companies in Iraqi markets, the method is based on the dissolving of ciprofloxacin in potassium hydroxide solution (i.e. potassium Ciprofloxacin salt), no intervention was found from tablet excipients at the chose wavelength and examination conditions.

This validated technique was used to investigate financially accessible particular brands of ciprofloxacin tablets delivered by four distinct organizations in the Iraqi.

EXPERIMENTAL

Apparatus

All absorbance measurements were conducted with a UV-VIS Spectrophotometer (Shimadzu 1650), 160 computerized twofold pillar record in and 1cm Quartz cuvette.

The estimation properties wavelength extends from (600-300nm), examining interim is 1.0, check speed is moderate, opening width: 2.0 nm, auto testing interim is debilitated, filter mode is single, measuring mode: absorbance. Light source change wavelength around 340.8 nm, S/R trade is ordinary, and UV Probe Software, micropipette and digital electric balance. All spectrophotometer measurements were at room temperature laboratory standard.

Chemicals used

Ciprofloxacin RS was supplied by the S.D.I. (Iraq) and utilized as standards (relegated purity 99.8%), Potassium hydroxide, the tablets contain (500mg) of ciprofloxacin were acquired in the Iraqi markets as mentioned in (Table 1), and all

other synthetic reagents were of investigative review.

Table 1: Ciprofloxacin tablets 500mg in Iraqi pharmacies.

NO.	TRADE NAME	COMPANY	Mad. D.	Exp. D.	BATCH NO.	*Average Wt. of Tablets (g)
1	Cipropharm	Pharma International Co. Amman- Jordan	04/2014	04/ 2017	14194	0.790
2	Ciproneer	Pioneer Co. Iraq	10/2013	10/ 2016	130141A	0.747
3	Microflox	MICRO LABs LIMITED - INDIA	08/2014	07/ 2018	MIFH0051	0.788
4	Bactiflox-500	Sofarimex, Cacem, Portugal for Acino. Miesbach, Germany	03/2014	03/ 2017	40295	0.762

*Average ten tablets weight

Preparation of Standard stock solution

Standard stock Ciprofloxacin solution (0.200g.L-1) was set up by dissolving (20.04mg) of purified Ciprofloxacin with (5mL) of potassium hydroxide (0.1eq/L) in (100mL) volumetric flask, afterwards diluting with D.W. to the stamp (as potassium ciprofloxacin salt) and then six diverse standard solutions (2.0 - 10.0µg/mL) were set up by transfer (0.500 -2.500 mL) of standard stock solutions in a volumetric flask (50mL) by micropipette, then diluting with D.W. To the stamp, the arrangements of standard solutions were listed in (Table.2).

Table.2: Absorbance of Standard solutions

Cons. (µg/mL)	ABS.	NOTES*
0	0	$Y = 0.0784 X + 0.0547$
2	0.216	Correlation Coefficient $R^2 = 0.9985$
4	0.363	Chi Square = 0.999999885
5	0.450	Standard Error of Estimate(SEE) = 0.009558
6	0.513	Relative Standard Deviation = 0.019475788 Multiple Correlation Coefficient $R^2 = 0.99854471$
8	0.694	Slope= 0.078363
10	0.835	Intercept = 0.054714

*Six consecutive replicate the solution of standard solution.

Samples preparation

For Ciprofloxacin tablets were utilized by various manufacturing companies in the Iraqi market was listed in Table1. Ten tablets of each type or source were weighed, then grounded to fine powders using mortar and pestle and a normal measure of comparable to (20mg) of Ciprofloxacin (sample solution) disintegrated with 5mL of KOH (0.1N) into a beaker then transfer into a volumetric flask (100mL), and diluting with D.W. to the mark.

Six solutions were prepared from the sample solution by moving (1.5mL) from the sample solution to the volumetric flask

(50mL) by micropipette then diluted with D.W. ($\approx$ 6.0 mg.L-1).

ABSORBANCE SPECTRUM of Ciprofloxacin

Transfer (1.375mL) of the standard stock solution (0.200 g/L) by micropipette up to the volumetric flask(50mL), and then diluted with D.W. to the mark, the standard solution (5.5 µg/mL) absorbance was measured at a range (600-300 nm).

The absorbance spectrum and max at (335nm) were shown in (Fig.2); A similar absorbance range appear for Ciprofloxacin tablets were utilized by various companies in the Iraqi market.
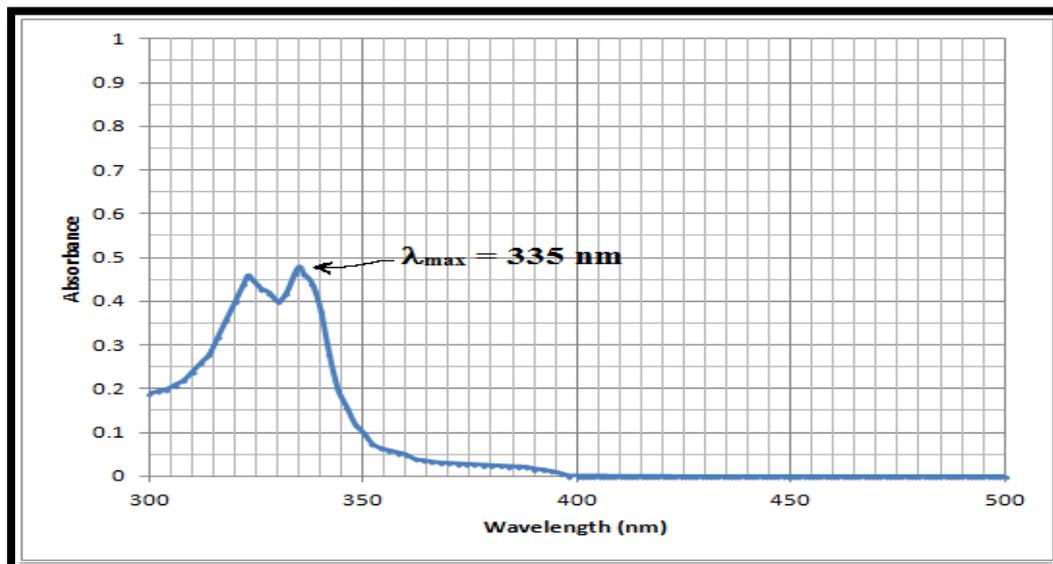

Fig.2: Absorbance spectrum of Ciprofloxacin (λ_{max} 335 nm)

Calibration curve

This technique was resolved at six concentration levels ranging from (2-10 mg/L) for Ciprofloxacin. The calibration curve was built up by plotting absorbance versus concentrations of Ciprofloxacin and the regression equation was calculated in which each observance was the average of six determinations of standard solutions. The linear absorbance data for the calibration curve was listed in (Table2) and (Fig.3).
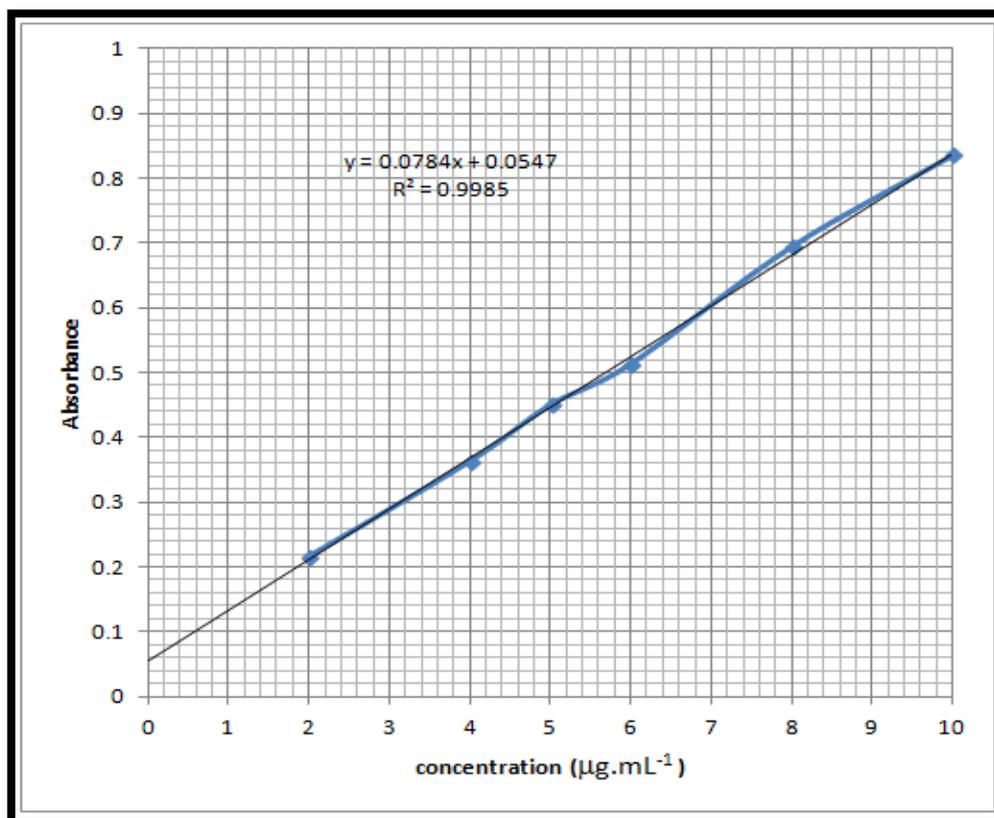
Fig. 3: The calibration curve for six concentrations

DISCUSSION THE RESULTS:

Linearity:

The linearity of the medication was obtained for the calibration curve; It has been shown to be linear in the stated concentration range of (2-10 μg.mL-1) and (Y= 0.0784X + 0.0547) as line equation, (R2=0.9985) as Correlation Coefficient, (+0.054714) as Intercept, (0.078363) as Slope, (SEE=0.009558) as Standard Error of Estimate, (0.999999885) as Chi-Square(The goodness of fit between observed values and those expected theoretically), (RSD=0.019475788) as Relative Standard Deviation, and (R2 =0.99854471) as Multiple Correlation Coefficient shown in (Table 2).

Accuracy and Precision:

The recovery of the technique (accuracy) was examined in which a solution containing Ciprofloxacin (Conce. = 2.0 – 10.0 mg/L) With no impurities identified with reference material at appropriate concentrations.

Accuracy and RSD obtained were shown in (Table 3) affirmed the satisfactory accuracy of a technique used in this study.

The low RSD (relative standard deviation) values indicate that this method is precise: The precision of the analytical system was explored by performing six consecutive replicates solution of the same standard solution. The SD (standard deviation) and RSD recorded in (Table 3).

Table.3: The Accuracy and precision values

Concentration of CIP (ppm)		Recovery* %	SD	R.S.D* %	Error* %	LOQ	LOD
Taken	Found*						
2	2.0025	100.125	0.01405	0.7018	0.125	1.79337	0.59181
4	4.00142	100.00035	0.00944	0.23582	0.00035	1.20416	0.39737
5	5.00167	100.01	0.00361	0.07227	0.01	0.461287	0.15222
6	5.998667	99.97778	0.005465	0.091104	0.02222	0.697401	0.230142
8	7.9999	99.99875	0.00348	0.043503	0.00125	0.444116	0.146558
10	10.00228	100.0228	0.003262	0.032614	0.0228	0.416288	0.137375

*Six consecutive replicate the solution of standard solution.

The Detection limit (LOD) and the Quantification limit (LOQ)

By the following equations:

LOD = 3.3 (SD/m)

LOQ = 10(SD/m)

The LOD and LOQ were Calculates from the standard deviation (SD) of responses and slope (m= 0.078363); As shown in (Table 3).

The LOD for Ciprofloxacin was (0.59181 - 0.137375 mg/L), while LOQ was up to (1.79337–0.416288 mg/L).

Validation method:

The method was approved through sensitivity, linearity, accuracy and precision, as listed in (Table 4).

Table 4: The technique Optical parameters and characteristics

NO.	PARAMETERS	RESULT
1	(λ_{max}) *	335 nm
2	Equation of Linear	Y = 0.0784 X + 0.0547
3	Linearity of Conce.	2-10 mg/L
4	Coefficient of Regression	0.9985
5	LOQ (ppm)	1.79337–0.416288
6	LOD (ppm)	0.59181 - 0.137375

*Wavelength at absorption maxima

The determination of active ciprofloxacin tablets in Iraqi markets

Commercially available different brands of Ciprofloxacin tablets manufactured from four companies in Iraqi markets.

This approved technique was used to determine of Ciprofloxacin. The results uncovered that three of the promoted brands are consistent with the sum prerequisite (90-110%) regarding the market claim in (Table 5); It was

discovered that Ciprofloxacin from Pharma International Company was the top weight percentage than others, While Acino Company was less concentration, in which the concentration of every obsorbance was resolved for no less than six sample solutions of each sample contrasted to the standard calibration curve in this technique.

The calculated weight percentage (Wt%), standard deviation (SD) and the validity of this technique could be demonstrated by analyzing authentic samples of the medication.

Table 5: Assurance of ciprofloxacin from ciprofloxacin tablets companies

NO	TRADE NAME	COMPANY	FOUND*(ppm)	SD	Wt%
1	Cipropharm	Pharma International Co. Amman- Jordan	5.7151	0.323	95.2514%
2	Ciproneer	Pioneer Co. Iraq	5.44392	0.34892	90.7319%
3	Microflox	MICRO LABs LIMITED – INDIA	5.3685	0.3779	89.475%
4	Bactiflox-500	Sofarimex, Cacem, Portugal for Acino. Miesbach, Garmany	4.587	0.22011	76.45%

* Normal of six sequential recreate arrangement of test arrangement.

Conclusions:

The fruitful method created UV spectroscopy become fundamental, shoddy, feasible, brief, and specific, with high exactness and accuracy values, the approval parameters had been assessed in step with Iraqi providers of wellbeing rules, the desirable investment of this work demonstrates that this investigation, a specialist can be related to the quantitative dedication of Ciprofloxacin from pharmaceutical dose frames, likewise this technique is probably utilized in routine best manage viewpoints.

At the factor while this method linked for the quantitative willpower of Ciprofloxacin capsules in markets of Iraq, the results confirmed that Ciprofloxacin drugs was recounted within the regular charge (ninety-110%) agreeing U.S. Pharmacopeia and The fitness Ministry of Iraq.

References:

1- N.X. Chin and H.C. Neu. Ciprofloxacin, a quinolone carboxylic acid compound active against aerobic and anaerobic bacteria. Antimicrobial Agents Chemother.25: 319–326 (1984).

2- "Ciprofloxacin- Hydrochloride"; The American Society ofHealth-system Pharmacists.Retrived 3 April 2011.

3- Drusano GL, Standiford HC, Plaisance K, Forrest A, Leslie J,Caldwell J, GL (Sept 1986) "Absolute oral bioavailability ofciprofloxacin" Anti microbe agents' chemother. 30 (3) : 44.

4- G.M. Eliopoulos, A. Gardella, and R.C. Moellering. In vitro activityof ciprofloxacin, a new carboxyquinoline antimicrobial agent.AntimicrobialAgents Chemother.25: 331–335 (1984).

5- Indian pharmacopoeia 2007; volume 2: 938-939.

6- en.wikipedia.org/wiki/ciprofloxacin

7- www.drugbank.ca / ciprofloxacin hydrochloride/ DB00537.

8- Husain, S.; Khalid, S.; Nagaraju, V.; NageswaraRao, R.; J. Chromatogr. A 1995, 705, 380.

9- Cazedey, E.C.L.; Perez, D.P.; Perez, J.P.; Salgado; Chromatographia, 2009, 69, 241.

10- United States Pharmacopoeia (USP); 31th ed. United States Pharmacopoeia Convention: Rockville, 2008.

11- FarmacopéiaBrasileira. 4.ed. São Paulo: Atheneu, 1988.

12- Mathur, S.C.; Lal, S.; Murugesan, N.; Rathore, Y.K.S.; Sethi and P.D.; Indian Drugs 1990, 27, 398.

13- Amin, A.S.; Moustafa, M.E.; El-Dosoky and R; Anal. Lett. 2008, 41, 837.

14- Edith Cristina LaignierCazedey, Hérida Regina and Nunes Salgado; A noveland rapid microbiological assayfor ciprofloxacin hydrochloride.Journal ofPharmaceuticalAnalysis2013;3(5):382–386.

15- Pandey S, Pandey P, Tiwari G, Tiwari R and Rai AK. FTIR spectroscopy: A tool for quantitative analysis of ciprofloxacin in pharmaceutical formulations. Indian Pharmsci 2012; 74[1]: 86-90.

16- Shihn −Sheng Wu, Chih-Yuan Chein, and Yen-Hsia Wen. An analysis of Ciprofloxacin by a Simple High-Performance Liquid Chromatography Method. Journal of Chromatographic Science, Vol. 46, July 2008.

17- Kharat Rekha, Jadhav Santosh, Tamboli Dilshadbee and Tamboli Ashpak. Estimation of Ciprofloxacin Hydrochloride in Bulk and Formulation by Derivative UVSpectrophotometric Methods, nternational Journal of Advances in Scientific Research 2015; 1(3): 137-144