RADS-JPPS Vol 3 (2), December 2015, 41-49

UV Spectrophotometric Method for Estimation of Moxifloxacin HCl in Tablet Dosage Form and Comparative Study of its Different Brands

Somia Gul, Fakhra Khalid, Maheen Nafees Khan and Muhammad Tanweer Alam

Faculty of Pharmacy, Jinnah University for Women Karachi, Pakistan

ABSTRACT

An accurate and economical spectrophotometric method for the estimation of Moxifloxacin HCl in tablet dosage form has been developed and validated. The comparative studies of its different brands were assessed through evaluation of official and non official standards such as disintegration and dissolution with the specification of US pharmacopeia. The proposed developed method was based on the UV absorbance, 0.1 M HCl used as a solvent. In this method Moxifloxacin shows wavelength maxima at 294nm and method was validated as per ICH guidelines for linearity, precision and accuracy. This proposed method was successfully applied for the analysis of different brands of Moxifloxacin tablets available in the market and recovery study also revealed that there was no interaction occurred from the excipients present in the tablet.

Keywords: *Moxifloxacin, Spectrophotometry, Validation, Disintegration, Dissolution.*

INTRODUCTION*

Moxifloxacin is an advanced new broad spectrum synthetic derivative of fluoroquinolones. It is an oral and 8 methoxyquinolone anti-microbial agent [1, 2], slightly yellow crystalline powder with the molecular formula of C21 H24 FN3 O4 having molecular weight of 401.43g/mol [3, 4, fig. 1].It is used for the treatment of acute bacterial exacerbation of chronic bronchitis community acquired pneumonia, skin and its related infections [5] and has great activity against streptococci, staphylococci and gram negative pathogens [6]. Moxifloxacin is a second-line agent used to treat tuberculosis [7, 8, and 9].

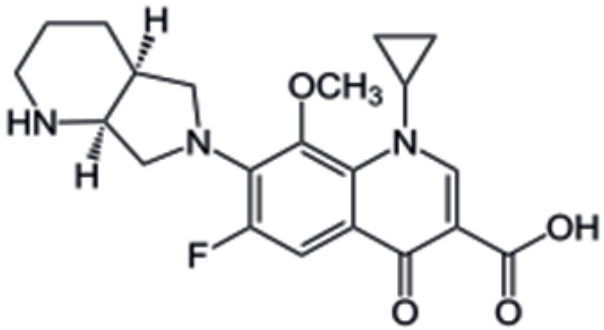

Fig. 1: Structure of Moxifloxacin

Corresponding Author: drsomi1983@yahoo.com

Literature survey revealed that more accurate and more reliable reversed-phase high-performance liquid chromatographic method was developed and validated for the determination of Moxifloxacin hydrochloride (MFLX) in pure drug and in tablets [10]. Another method was developed and validated and also applied successfully for the estimation of tinidazole and Moxifloxacin in tablet [11].The simple and sensitive validated UV Spectrophotometric method was developed for the determination of Moxifloxacin in bulk and pharmaceutical formulations [12]. The simultaneous determination of Moxifloxacin (MOX) and H2- receptor antagonists was developed in bulk and its formulations first time. The method is applicable for routine analysis of formulations and MOX with H2-receptor antagonist interaction also [13]. Spectrofluorimetric method has been developed

to determine the antibiotic Moxifloxacin and applied to human urine, serum and also in pharmaceuticals [14]. Comparison of microbiological assay and HPLC is performed in ophthalmic solutions and human plasmafor Moxifloxacin determination.Analysis of Moxifloxacin tablets and ophthalmic solutions by both methods gives similar potencies [15].

The objective of the study was to develop and validates UV spectrophotometric method of MoxifloxacinHCl tablet using 0.1 M HCl as solvent for the estimation of Moxifloxacin in pharmaceutical formulation. Moreover, comparative study of Quality Control parameters of five different brands of MoxifloxacinHCl tablets marketed in Karachi has been conducted. These tablets were assessed through the evaluation of official and non official standards such as disintegration and dissolution with the specification of US pharmacopeia.

EXPERIMENTAL

Instruments and Reagents:

The MoxifloxacinHCl film coated tablets having label strength of 400mg of five different brands were purchased from market in Karachi and the study was performed within product expiration date. Disintegration and dissolution tests were performed on a "Disintegration tester electro lab (ED-2L)" and "Electrolab TDT-086 India" respectively.

Spectrophotometric analysis has been carried out or a "Schimadzu UV-1700 spectrophotometer" with 1 cm cell. All samples were weighted on an analytical Sartorius balance "CPA225D". Calibrated glass wares, sonicator i.e. ultrasonic "LC60H Elma Japan" and magnetic stirrer "MS-17GB Korea" was used for this study.

Raw material of MoxifloxacinHCl of Known potency 99.76% is taken from one of theindustryin Karachi. The Spectrophotometric method was carrying out on a multinational brand "Moksi 400mg" (Abbot Pharma) marked as MOX-01*. The solvent 0.1M HCl analytical grade was used.

Methodology:

Disintegration Test:

The disintegration test was performed on 6 tablets from individual brand as per procedure and specification. The disintegration time of 6 tablets of individual brand was determined at 37.5˚C in distilled water using disintegration tester (USP) Electrolab (ED-2L) apparatus. Thedisintegration time is taken to be the time when no granule of any tablet is left on the mesh. Results of all brands were recorded in Table-1.

Table 1. Disintegration Test Analysis of Different Brands of Moxifloxacin

Serial No	Batch No	Disintegration Time	Official Limit	Comments
MOX – 01*	35984XY	3 min	Not more than 30 min	Within specified limit
MOX – 02	A1864	5min	Not more than 30 min	Within specified limit
MOX – 03	010	11 min	Not more than 30 min	Within specified limit
MOX – 04	M5F31	8 min	Not more than 30 min	Within specified limit
MOX – 05	4791	4 min	Not more than 30 min	Within specified limit

2. Dissolution Test:

The Dissolution test was conducted using USP paddle method (Apparatus 2) on tablets from individual brand. This was determined by using aElectrolab TDT-086 containing 900ml of 0.1M HCl maintained at 37±0.5˚C with a fixed speed of 100 rpm. A tablet put from each brand in each of compartments and the machine operated at the interval of 30 minutes and then 10ml of the sample was withdrawn at specified interval. Absorbance of withdrawn sample at 294nm was measured using UV–Visible spectrophotometer. The concentration of the MoxifloxacinHCl in the sample was calculated according to Moxifloxacin monograph in authorized USP. Results were shown in Table-2.

Solvent Selection for Developed Method:

0.1N HCl was used to establish the absorption maxima (λmax) &Moxifloxacin at 5µg/ml concentration. HClwas used as solvent & showed absorbance of 0.647 at 294nm for the estimation of Moxifloxacin in Moksi 400mg tablet marked as MOX – 01*and results shown in Table-3.

Preparation of Standard Solution:-

Accurately weighed & transferred MoxifloxacinHCl about 114mg into a 200ml clean and dry volumetric flask. Dissolve & dilute it with freshly prepared 0.1M HCl to the volume. Further dilute 2 ml to 200 ml with 0.1 M HCl to the volume to get a concentration of 5µg/ml.

Take the absorbance of standard preparation at the maximum 294nm using 0.1M HCl as the blank.

Estimation of Moxifloxacin in Tablets:

Weigh & powdered 20 tablets. Transferred about 181.5mg of crushed powder containing

Table 2(A). Absorbance of Different Brands at 30 Minute Time Interval at 294 nm

S. No.	Serial No.	Absorbance of drug at 294 nm at 30 minute
1	MOX – 01*	1.018
2	MOX – 02	1.014
3	MOX – 03	1.013
4	MOX – 04	0.995
5	MOX – 05	1.006

Table 2 (B). Official Limits at 294nm

S . No.	**Serial No.**	**Batch No**	**% Dissolution at 30 min**	**USP Specification**	**Deviation from USP**
1	MOX – 02	A 1864	99.60%	not less than 80%	within specified limit
2	MOX – 03	010	99.50%	not less than 80%	within specified limit
3	MOX – 04	115F31	97.74%	not less than 80%	within specified limit
4	MOX – 05	4791	98.82%	not less than 80%	within specified limit

Table 3. Absorbance of Drug (MFLX) in Selected Solvent

Conc. µg/ml	**Solvent**		**λ max**	**Absorbance**
5µg/ml	0.1N HCl	294 nm	0.647	

Table 4. Estimation of Moxifloxacin in Tablets:

Formulation	Labeled Amount (mg)	Amount Obtained (mg/ Tab)	%Potency
MOX – 01*	400 mg	399.17mg	99.79

* Average of three determinations.

Table 5. Accuracy of the Developed Method

Claim amount	Sample	Conc. of Moxifloxacin (formulation) µg/ml	Abs.	% Recovery of Moxifloxacin	Statistical analysis
320mg/tab	80%	4 µg/ml	0.450	79.905	Mean = 80.31%
	80%		0.452	80.31	SD = 0.4453
	80%		0.455	80.79	%RSD = 0.5545
400 mg/tab	100%	5 µg/ml	0.562	99.79	Mean = 100.26%
	100%		0.564	100.15	SD = 0.5444
	100%		0.568	100.86	%RSD = 0.543
480 mg/tab	120%	6 µg/ml	0.671	119.15	Mean = 119.56%
	120%		0.674	119.68	SD = 0.369
	120%		0.675	119.86	%RSD = 0.308

the equivalent of 100mg Moxifloxacin into 200 ml volumetric flasks and add 0.1 M HCl then sonicate for 10 minutes. Mix on a magnetic stirrer for 30 minutes & then filtered through filter paper. Discard the first 5 ml of filtrate & transfer 2ml of the filtrate to 200ml volumetric flask and dilute with 0.1M HCl to the volume to form 5µg /ml.

Take the absorbance at 294nm using 0.1M HCl as the blank & the drug content is estimated. The results were shown in Table-4.

OPTIMIZATION OF DEVELOPED METHOD

1. Accuracy

The accuracy of an analytical method is the closeness of test results obtained by that method to the true value. The ICH guidelines recommend that accuracy be assessed using a minimum of nine determinations over a minimum of three concentration levels, covering the specified range (i.e. three concentrations and three replicates of each concentration, which are concentration in the range of 80%, 100% & 120% of Moxifloxacin. The values of SD, Mean, % RSD were calculated in Table-5.

2. Precision

The precision of an analytical method is the degree of agreement among individual test results when the method is applied repeatedly to multiple samplings of a homogeneous sample. It may be a measure of either the degree of reproducibility or repeatability of the analytical method under normal conditions.

The ICH documents recommend that repeatability should be assessed using a minimum of nine determinations covering the specified range for the procedure (i.e. three concentrations and three replicates

Table 6. Precision of the Developed Method

Sample	Label claim	Conc. of Moxifloxacin (µg/ml)	Abs.	Statistical analysis
MOX – 01*	400 mg	5	0.561	Mean = 0.563 SD = 0.0014 %RSD = 0.261
		5	0.564	
		5	0.562	
		5	0.565	
		5	0.564	
		5	0.563	

Table 7. Intra-day precision results

Parameter	% Recovery Estimation (mean + RSD)		
	4µg/ml (80%)	5µg/ml (100%)	6µg/ml (120%)
At 0 hour	80.31	100.26	119.56
At 12 hour	80.32	100.28	119.56
At 24 hour	80.30	100.27	119.54
Mean	80.31	100.27	119.55
SD	0.01	0.01	0.01
%RSD	0.0124	0.0099	0.0096

(Limit of %RSD = Not more than 2%)

Table 8. Inter-day precision results

Parameter	% Recovery Estimated (mean + RSD)		
	4µg/ml (80%)	5µg/ml (100%)	6µg/ml (120%)
Day 1	80.91	99.98	118.50
Day 2	80.90	100.01	119.21
Day 3	80.92	100.05	119.15
Mean	80.91	100.013	118.95
SD	0.01	0.035	0.393
%RSD	0.0123	0.0351	0.3310

(Limit of %RSD = Not more than 2%

of each concentration or a minimum of six determinations at 100% of the test concentration).

The precision of proposed method was ascertained from the nine determinations of a fixed concentration of the formulation and find the absorbance.

The concurrent values i.e. mean,standard deviation & %RSD were recorded in Table-6.

Inter- day precision:-

Inter-day precision is taken by analyzing the three different concentration of drug on same day at different time interval i.e. after 0 hr, 12 hrs and 24 hrs and take the absorbance at 294

Table 9. Comparison of Assay of Standard and Sample

Result of Assay		
Standard	Sample	Difference
99.76%	99.79%	0.03%

(Limit = ± 1.0%)

Table 10. Linearity of the Developed Method

Lin earity range	Concentration %w/v	Average Potency	Absorbance
At 80 %	0.0004	80.35%	0.452
At 90 %	0.00045	89.42%	0.503
At 100 %	0.0005	99.91%	0.562
At 110 %	0.00055	107.02%	0.620
At 120 %	0.0006	119.82%	0.674

nm. The results were shown in Table-7.

Intra-day precision:-

Intra-day precision is carried out by taken the absorbance of same solution on 1st, 2nd and 3rd day. The results were recorded in Table-8.

3. Specificity

It is the comparison of the assay results of raw material (STD) & sample solution of Moxifloxacin 400mg tablet. It shows that any inactive ingredients are not interacting in the assay. The test performed as follows.

Raw material of Moxifloxacin HCl has been taken and then assay has been done whose results are shown below:

Assay result of Standard

Item	Moxifloxacin Hydrochloride
Determined potency	99.76%

Assay result of Sample

Sample	Moxifloxacin Tab 400 mg
Determined potency	99.79%

Then compare the both above mentioned results & shown in Table-9.

4. Linearity & Range

Linearity should be established across the range of the analytical procedure (80%, 90%, 100%, 110%, 120 %,). It should be established initially by visual examination of a plot of signals as a function of analyte concentration of content. If it appears to be a linear relationship then test results should be established by appropriate statistical methods. Data from the regression line may be helpful for providing mathematical estimates of the degree of linearity, the coefficient correlation, Y-intercept and Slope of the regression line. Values recorded in Table-10 and graph in Fig.-1.

Sample : Moxifloxacin Tablet 400mg

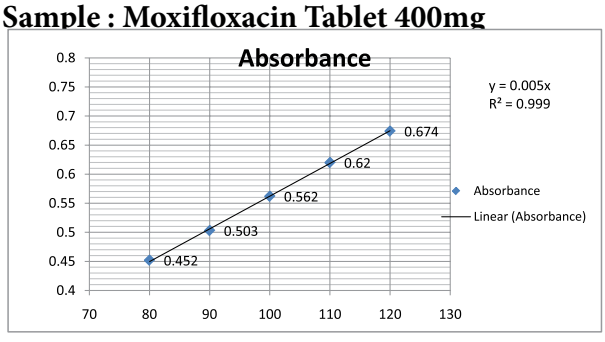

Fig. 2. Linearity of the Developed Method for Moxifloxacin Tablet 400mg

Table-11. Characteristics Parameters of Validation

Parameters	Results and Acceptance criteria
Accuracy	Percent recovery 95% to 105%
Precision	%RSD not more than 2%
Specificity	0.03% (limit ± 1.0 %)
Linearity	Visually linear
Range	Acceptable degree of linearity between 80% to 120%
Correlation coefficient (r)	0.9995
Slope (a)	0.00561
Intercept (b)	0.0012
Coefficient of determination (r2)	0.9997
Regression equation (Y)	0.0056X

RESULT AND DISCUSSION

The results of the quality control parameters such as Disintegration and Dissolution of five brands of Moxifloxacin HCl film coated 400mg tablets and also validate a simple, sensitive and accurate developed UV spectrophotometric method for determination of Moxifloxacin in pharmaceutical dosage form are discussed. The four brands i.e. MOX-02, MOX-03, MOX-04, MOX-05 compared with the multi-national brand used as standard i.e. MOX-01*. The assessment involved evaluation of disintegration and dissolution studies.

The disintegration results of Table-1 showed that all brands passed the disintegration test according to US pharmacopeia which specifies 30 minutes for film coated tablets.

According to the USP monograph for each of the tablets tested for dissolution test, the amount of active ingredient in solution is not less than 80% of the prescribed or stated amount. Disintegration test is a crucial step in release of drugs from immediate release dosage forms. The disintegration rate is directly proportional to the dissolution rate. The results obtained from the dissolution studies stated in Table-2 (B) of dissolution revealed that all the brands passed the USP specifications standard for dissolution rate test for conventional release tablets. In developed proposed method, 0.1 M HCl found to be better as solvent. The characteristics of that proposed method found that the Moxifloxacin HCl brand i.e. MOX-01* obey linearity within the concentration range in the UV region. The %RSD is not more than 2% which shows that the developed method has a greater reproducibility i.e. mention in Table-6. The recovery percentage values of Moxifloxacin in analyzed dosage form is between 79.905% to 119.86% i.e. recorded in Table-5 and assay value of that formulation is found to be within the limit and shown in Table-4. The all parameters of validation for Moxifloxacin that are performed in this study were incorporated in Table-11. The validation parameters showed that the proposed developed method is accurate and sensitive to analyze the bulk solution as well as its pharmaceutical dosage form in Quality Control laboratory as results of all validation parameters were within the specified limit.

The results obtained from the validation parameters of the method in "Moxifloxacin Tablet 400mg" give the evidence that on different parameters, the method is well optimized and reproducible. The developed method would be beneficial for future studies for estimation of Moxifloxacin in tablet dosage form.

CONCLUSION

An accurate, sensitive and reliable UV spectrophotometric method has been developed and validated for Moxifloxacin HCl tablet using 0.1 M HCl as solvent for the estimation of Moxifloxacin in pharmaceutical formulation. Moreover, comparative study of Quality Control parameters of five different brands of Moxifloxacin HCl tablets marketed in Karachi has been conducted and found results within the pharmacopeial limits.

REFERENCES

1 Barman B., Julia A .and Lamb, Harriet M, Drugs. 2000; 59:116.

2 Budavari S., Eds, In; The Merck Index. 13th edition, Merck and Co., Inc., Whitehouse station, NJ. 2001; 1097 and 1125.

3 Siddartha B., Babu I. S., Parthiban C., A novel and validated UV-Spectrophotometric method for estimation of Moxifloxacin in bulk and tablet dosage form. International Journal of Pharm Tech Research CODEN (USA). 2013; 5(4):1722-1727.

4 Farjahan N, Rahman A., Sultan Md. Z., Giasuddin M., Rashid M. A., Hassan A. and Ahmad M., Development and Validation of a RP-HPLC Method for simultaneous determination of Levofloxacin and Moxifloxacin in pharmaceutical dosage forms. Journal of Basic & Applied Sciences. 2013; 9:633-638.

5 Patel P.U., Suhagia B.N., Patel M. M., Simultaneous spectrophotometric determination of Moxifloxacin and Metronidazole in synthetic mixture by simultaneous equations method, Indian drugs, 2005; 42(3):155-157.

6 Miller D., Review of Moxifloxacin hydrochloride ophthalmic solution in the treatment of bacterial eye infections. Clin Opthalmol. 2008; 2(1): 77-91.

7 Subbaiah P. R., Kumudhavalli M. V., Saravanan C., Kumar M. and Chandria R M., Method development and validation for estimation of Moxifloxacin HCl in tablet dosage form by RP-HPLC method. Pharmaceutica Analytica Acta. doi. 2010; 10, 4172/2153-2436.1000109.

8 RazzaqS. N., KhanI. U., Marium I. and Razzaq S. S., Stability indicating HPLC method for the simultaneous determination of Moxifloxacin and Prednisolone in pharmaceutical formu-lations. Chemistry Central Journal. 2012; 6:94.

9 Marc M. Sep. Moxifloxacin in the management of exacerbations of chronic bronchitis and COPD. Int J Chron Obstruct Pulmon Dis. 2007; 2(3): 191-204.

10 Safwan A. High-Performance Liquid Chromatographic Analysis of Moxifloxacin antibiotic using photodiode array detector. Res. J.of Aleppo Univ. Basic Science Series no. 78, 2011.

11 Siddartha B., Sudheer I. B., Ravichandra G., Parthiban C., Analytical method development and validation for simultaneous estimation of Tinidazole and Moxifloxacin in bulk and pharmaceutical dosage form by RP-HPLC method. World Journal of Pharmacy and Pharmaceutical Sciences. 2014; 3(3):1138-1148.

12 SahuS. K., AzamMd. A., Sahu D., and BanarjeeM., (2011) Spectrophotometric estimation of Moxifloxacin in bulk and its pharmaceutical formulations. Pharmacology online. 2011; 2: 491-502.

13 Sultana N., Akhtar M., Shamim S. and Gul S., Simultaneous determination of Moxifloxacin and H2 Receptor antagonist

in pharmaceutical dosage formulations by RP-HPLC: Application to in vitro drug interactions. Quim. Nova. 2011; 34(4):683-688.

14 OcanaJ. A., Barragan F. J.and CallejonM., Spectrofluorimetric determination of Moxifloxacin in tablets, human urine and serum. Analyst. 2000; 125, 2322-2325. DOI: 10.1039/b005991i.

15 Abdelaziz A. A., Elbanna T. E., Gamaleldeen N. M., Validated microbiological and HPLC methods for the determination of Moxifloxacin in pharmaceutical preparations and human plasma. Brazilian Journal of Microbiology, 1291-1301. ISSN 1517-8382, (2012).


جناح یونیورسٹی برائے خواتین
JINNAH
UNIVERSITY
FOR WOMEN