Research Article

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Quantitative Determination of Meloxicam in bulk and in tablet by UV-Spectrophotometry

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Abstract:
Three simple, precise and economical UV-Spectrophotometric methods have been established for the quantification of meloxicam in bulk and in tablet. Zero order spectrophotometer determination was done at 269 nm in method I; in method II, Area under curve was done in the wavelength range of 254-279 nm; whereas, zero order spectrum was derivatized into first order ($\Delta\lambda$=2) at wavelength 275 nm in method III. In method I and II, meloxicam obeyed linearity in the concentration range of 5-30 µg/ml while in method III, 50-300 µg/ml, respectively with r^2 obtained as 0.999, 0.998 and 0.999. Calibration curves were plotted using instrument response between particular wavelengths and concentrations of analyte in the solution. The proposed methods were successfully applied for the determination of meloxicam in commercial tablets and amount found to be 99.81%, 100.15% and 100.07% respectively. The proposed methods were validated as per ICH guidelines for accuracy, precision, repeatability and ruggedness.

Keywords: Meloxicam, UV spectrophotometry, validation, area under curve, first order derivation

Introduction

Meloxicam (MLX) [Fig. 1] is an oxicam derivative and a member of the enolic acid group of Non steroidal anti-inflammatory drugs (NSAIDs). It is chemically designated as 4-hydroxyl- 2-methyl-N-(5-methyl-2-thiazolyl)-2H-1, 2-benzothiazine-3-carboxamide-1, 1-dioxide. MLX exhibits anti-inflammatory, analgesic and anti-pyretic activities, especially in various chronic conditions, like osteoarthritis, rheumatoid arthritis, and polyarticular course juvenile rheumatoid arthritis. The mechanism of action of MLX is believed to be due to inhibition of prostaglandin synthesis, primarily via inhibition of cyclooxygenase. In contrast with other NSAIDs, it has neither acute nor chronic gastrointestinal toxicity [1].

Various analytical techniques *viz*, LC-MS-MS [2], potentiometry , HPLC [3-4], HPTLC [5-6] and UV spectroscopy [7-10] reported for the analysis of MLX in pharmaceuticals. HPLC is the most commonly used method for analysis of MLX. The primary objective of the present work was thus to develop and validate a UV-spectrophotometric method for MLX, which could also be employed for the routine analysis of the drug in pharmaceutical dosage forms. Three methods *viz,* Zero Order UV-Spectrophotometric, Zero Order UV-Spectrophotometric using AUC technique and First Order Derivative UV-Spectrophotometric are reported in the present study. The methods are validated in accordance with ICH guidelines [11-12] for accuracy, precision, repeatability and ruggedness.

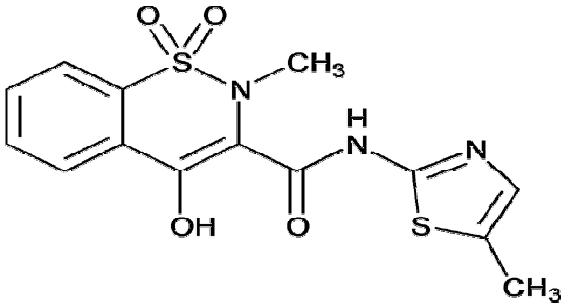

Fig. 1 Chemical structure of meloxicam

Materials and Method

Meloxicam working standard was obtained as gift sample from Cadila Health Care Ltd., Ahmadabad (India). Sodium hydroxide purchased from Lobe Chemie Pvt. Ltd., Mumbai and double distilled water was used throughout the study. A UV-Visible Spectrophotometer Shimadzu 2450 with UV Probe 2.21 software was used.

Preparation of standard stock solution

Standard stock solution was prepared by dissolving 10 mg of MLX in 0.1N sodium hydroxide solution to obtain the final concentration of 100µg/ml.

Determination of linearity

Method I (Zero order spectrometry)

Series of dilutions of standard solutions were prepared in 10 ml volumetric flasks with 0.1N NaOH to get the concentration range of 5-30 µg/ml. The above solutions were scanned over 200-400nm against reagent blank. The λ max was found to be 269 nm. The calibration curve was constructed by plotting concentration against absorbance [Fig. 2a and 2b].

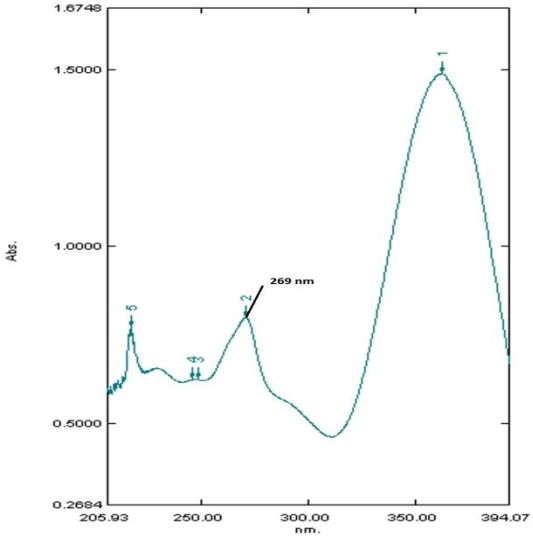

Fig.2a Zero order Spectrum of Meloxicam

Method II (Zero Order UV-Spectrophotometric method using AUC)

The above mentioned concentration range of 5-30 µg/ml was used to perform zero order using AUC by scanning the resulting solution over the range of 200-400nm. Zero order spectrum of MLX obtained and two wavelengths 253nm and 279nm were integrated for calculating AUC. The calibration curve was constructed by plotting concentration against absorbance [Fig. 3a and 3b].

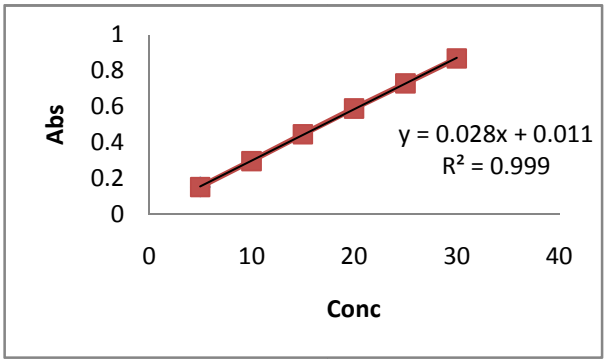

Fig. 2b Calibration curve of meloxicam (method I)

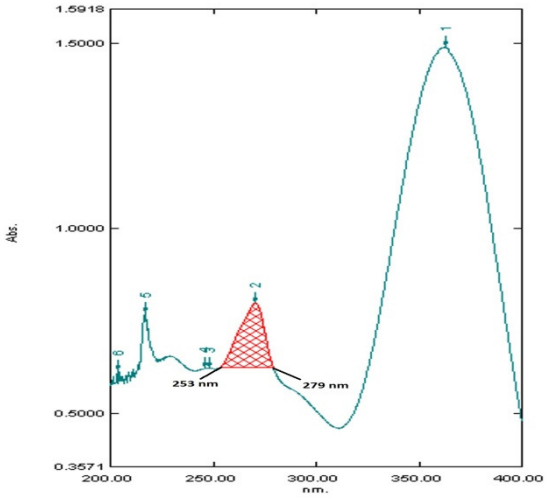

Fig. 3a Zero order AUC spectrum of meloxicam

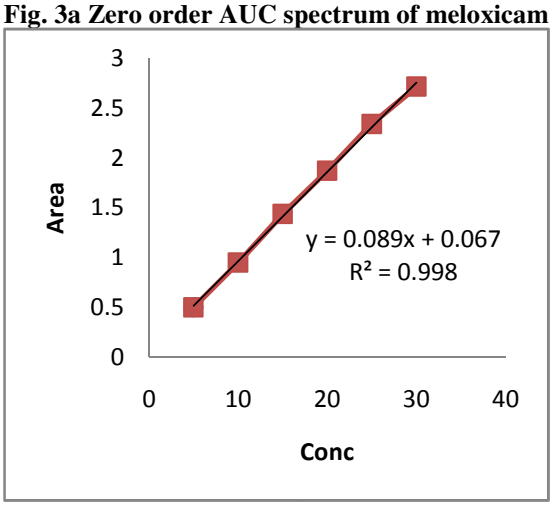

Fig. 3b Calibration curve of meloxicam (method II)

Method III (First order derivative UV-Spectrophotometric method)

Stock solutions was further diluted to obtain the concentrations in the range of 50-300 µg/ml and scanned over the range of 200-400nm. The zero order spectra of MLX were derivatized into first order (Δλ=2, scaling factor = 8) and the wave length 275 nm were selected for determination. The calibration plot was constructed as concentration *vs* amplitude [Fig. 4a and 4b].

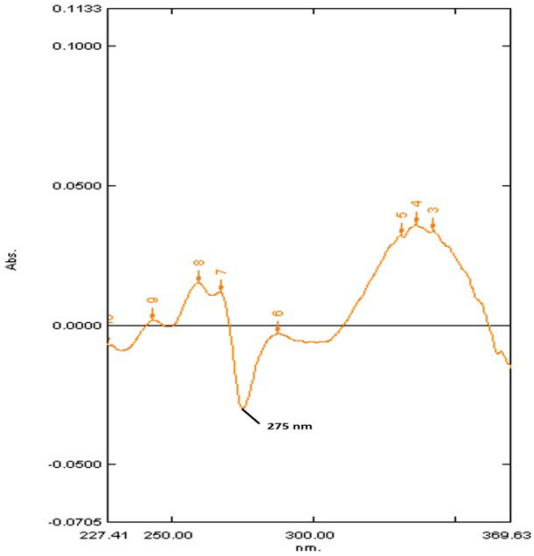

Fig. 4a First order derivative Spectrum of meloxicam

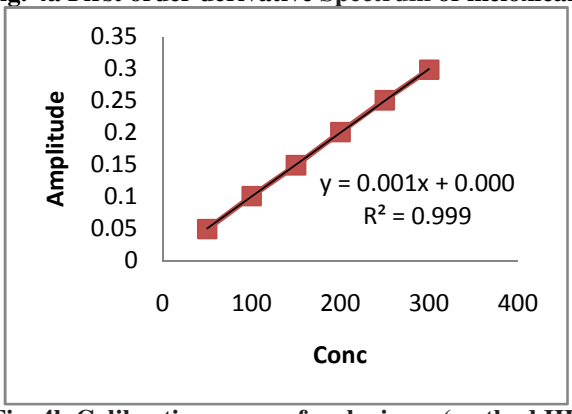

Fig. 4b Calibration curve of meloxicam (method III)

Determination of meloxicam in bulk

Accurately weighed 10mg of MLX was transferred into 100ml volumetric flask containing 20ml 0.1NNaOH and volume was made up to the mark. Accurate volume 1.5 ml of solution was transferred to 10ml volumetric flask and volume was adjusted to mark. The resulting solution was scanned on spectrophotometer in the UV range 200-400nm and absorbance, area; amplitude of corresponding trough was measured at 269 nm, 253-279 nm, and 275 nm. The concentrations of the drug were calculated from linear regression equations.

Analysis of tablet formulation

To estimate MLX in tablet formulation twenty tablets were accurately weighed, average weight determined and ground into fine powder. A quantity of powdered drug equivalent to 10mg of MLX was transferred to 100ml volumetric flask containing 40ml of 0.1N NaOH, sonicated for 15 min; volume was adjusted to mark with same solvent and filtered through Whatmann filter paper No.41. Resulting solution (100µg/ml) was further diluted with same solvent. The concentration of MLX determined in the methods using respective linearity curves.

Validation of proposed methods

Accuracy (Recovery Studies)

The accuracy of the proposed methods was studied by calculating mean % recovery performed at three different levels i.e. 80%, 100% and 120%. To the pre-analyzed sample solution a known amount of MLX bulk drug was added at 80%, 100% and 120% then re-analyzed by proposed method.

Precision

Precision of the method was studied as intra-day and inter-day variations. Intra-day precision was determined by analyzing the 10, 15, 20 µg/ml of MLX solutions for method I, method II and 100, 150, 200 µg/ml for method III; three times in the same day. Inter-day precision was determined by analyzing daily for three consecutive days.

Repeatability

Repeatability of proposed method was determined by analysing 15µg/ml concentration of MLX solution for six times.

Ruggedness

Ruggedness of the proposed method is determined for 15µg/ml (method I, II) and 150µg/ml concentration (method III) of MLX by analysis of aliquots from homogenous slot by two analysts using same operational and environmental conditions.

Results and Discussion

The linear regression data for calibration curves showed good linear relationship as all methods were found to obey Beer's-Lamberts law. The correlation coefficient (r^2) was found to be 0.999, 0.998 and 0.999 respectively. The details of optical characteristics are in Table1.

The of bulk analysis of MLX showed good assay as indicated by results obtained as 99-101% with % RSD less than 2. The concentrations of the drug were calculated from linear regression equations and the mean of six estimations was determined at each level [Table 2].

The tablet formulation was also assayed in order to assess the authentication of method. The amount in the tablet formulation was found to be 99-100% with % RSD less than 2, indicating that the method was specific for determination of MLX in pharmaceutical formulation. Results also indicate that there was no interference from the excipients occurs in tablet formulation [Table 3].

Table 1: Linearity studies for proposed methods

Parameters	Method I	Method II	Method III
Beer-Lambert's range (µg/ml)	5 – 30	5 – 30	50 – 300
λ max (nm) / wave length range (nm)	269	253- 279	275
Regression Equation	0.028X+ 0.011	0.089X+0.067	0.001X+0.0006
Correlation coefficient (r^2)	0.999	0.998	0.999

Table 2: Analysis of meloxicam in bulk

Methods	Concentration (µg/ml)	Amount found (µg) Mean ± S.D (n=6)	Amount found (%) Mean ± S.D (n=6)	% R.S.D*
I	15	14.95 ± 0.24	99.69 ± 1.60	1.61
II	15	15.23 ± 0.23	101.55 ± 1.55	1.53
III	150	149.97 ± 1.27	99.98 ± 0.84	0.84

Table 3: Analysis of tablet formulation

Methods	Concentration (µg/ml)	Amount found (µg) Mean ± S.D(n=6)	Amount found (%) Mean ± S.D(n=6)	% R.S.D*
I	15	14.97 ± 0.19	99.81 ± 1.29	1.29
II	15	15.02 ± 0.18	100.15 ± 1.23	1.23
III	150	150.11 ± 1.83	100.07 ± 1.22	1.22

Table 4: Summary of validation parameters for proposed methods

Parameters	Method I (Zero order)	Method II (AUC)	Method II (First order)
Recovery studies % RSD (n=3)	0.10-1.28	0.14-1.35	1.38-1.54
Precision % RSD			
Inter-day (n=3)	1.16	0.79	1.08
Intra-day (n=3)	1.07	1.16	0.95
Repeatability %RSD(n=6)	1.4	1.23	1.61
Ruggedness (%R.S.D)			
Analyst-I(n=6)	1.42	1.74	1.74
Analyst-II(n=6)	1.86	0.73	1.11

The proposed method was validated as per ICH guidelines for various parameters like accuracy, precision, repeatability and ruggedness. The proposed methods when used for extraction and subsequent estimation of drug from tablet dosage form, after adding a known amount of standard stock solution at different levels i.e. 80, 100 and 120% to the pre-analyzed sample solutions, afforded a good recovery with % RSD less than 2% indicating that the methods are more accurate. The precision studies were performed as inter day and intraday precision. It was expressed in terms of % RSD for proposed method and found to be less than 2. This indicates that the proposed method is more precise for the determination of both in bulk drug and in tablet. The results depicted revealed high precision of the methods.

Repeatability was determined by analysing 15 µg/ml of MLX solution for six times and the % amount found was between 99-102% with % R.S.D less than 2. Ruggedness of the proposed methods was determined by analyzing aliquots from homogenous slot 15µg/ml (method I, II) and 150µg/ml (method III) by different analyst using similar operational and environmental conditions. The results are reported in terms of % RSD. The result showed that the % RSD was less than 2% indicating that the proposed methods are highly rugged. The details of validation parameters for all three proposed methods were tabulated in following table 4.

Meloxicam was found to obey Beer- Lambert's law for all the three proposed methods which are developed and validated as per ICH guidelines. These UV spectrophotometric techniques are quite simple, accurate, precise, reproducible and sensitive. The UV method has been developed for quantification of MLX in tablet formulation. The validation procedure confirms that these are an appropriate method for quantification in tablet formulation. Thus it can also be used in routine quality control of the raw materials as well as formulations containing this entire compound.

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References

1. O' Neil MJ. The Merck Index: An Encyclopedia of chemicals, drugs and biologicals, 14th Ed. New Jersey: Published by Merck Research Laboratories, Division of Merck and Co., Inc. Whitehouse station.1996; 12.
2. Rigato H, Mendes G, Borges N, et al. Meloxicam determination in human plasma by HPLC coupled with tandem mass spectrometry (LC-MS-MS) in Brazilian bioequivalence studies. Inter. J. Clinc. Pharm. Thera. 2006; 44(10): 489-498.
3. El-Ries A, El-Dars F, Attia F, et al. Potentiometric and HPLC methods for the determination of meloxicam in bulk and drug formulations. Insight Pharm. Sci. 2012, 2(1).
4. Arayne M, Sultana N, Siddiqui F. A new RP-HPLC method for analysis of meloxicam in tablets. Paki. J. Pharm. Sci. 2005; 18(1): 58-62.
5. Desai N, Amin. Stability indicating HPTLC determination of meloxicam. Ind. J. of Pharm. Sci. 2008; 70(5): 644-647.
6. Starek M, Krzek J. TLC Determination of meloxicam in tablets and after acidic and alkaline hydrolysis. Acta. Pol. Pharm. 2012; 69(2): 225-235.
7. Master S, Mehta R, Bhatt K, et al. First order derivative spectroscopic method for simultaneous estimation of meloxicam and paracetamol in their combined dosage form. Inter. J. of Res. in Pharm. and Chem. 2011; 1(2): 193-198.
8. Nemutlu E, Kir S. Validated determination of meloxicam in tablets by using UV Spectrophotometry. J. of Faculty of Pharm., 2004; 24(1): 13-24.
9. Sawant R, Joshi R, Kawade D, et al. Development and validation of spectrophotometric methods for simultaneous estimation of paracetamol and meloxicam in pure and tablet dosage form Der Pharmacia Letters. 2010; 2(2): 471-478.
10. Khan F, Lohiya R, Umekar M, Development of UV Spectrophotometric method for the simultaneous estimation of meloxicam and paracetamol in tablet by simultaneous equation, absorbance ratio and absorbance correction method. Inter. J. of Chem Tech Res. 2010; 2(3): 1586-1591.
11. Text on Validation of analytical procedures, International Conference on harmonization. ICH guidelines Q2A; 1994.
12. Validation of analytical Procedures; Methodology. International Conference on harmonization, ICH guidelines Q2B;1996.