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VALIDATED ANALYTICAL METHOD DEVELOPMENT FOR THE DETERMINATION OF MELOXICAM BY UV SPECTROSCOPY IN API AND PHARMACEUTICAL DOSAGE FORM

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ABSTRACT

A simple, precise and specific spectroscopy method for quantitative estimation of Meloxicam in API and in pharmaceutical dosage form was developed and validated. Meloxicam showed maximum absorbance at 365 nm by using ethanol as a solvent. The linear calibration curve obeys Beer-Lambert's law in the concentration range of (2-18µg/ml) with regression equation of curve was y=0.050x-0.005 and the correlation coefficient was found to be (R^2=0.997). Validation of this method was done and applied to the estimation of Meloxicam in pharmaceutical dosage form, no interference was found in the absorbance of the drug in the presence of the common excipients and analysis conditions.

Keywords: UV Spectroscopy, Calibration curve method, Analytical Method, Validation, Meloxicam

INTRODUCTION

Meloxicam is a nonsteroidal anti-inflammatory drug (NSAID) a selective cyclooxygenase-2 (COX-2) inhibitor, belonging to the class of an oxicam derivative. Meloxicam is chemically designated as 4-hydroxy-2-methyl-N-(5-methyl-1,3-thiazol-2-yl)-2H-1,2-benzothiazine-3-carboxamide-1, 1-dioxide). Its empirical formula is $C_{14}H_{13}N_3O_4S_2$. The molecular weight is 351.4 g/mol. [1] Chemical structure of Meloxicam showed in figure1.

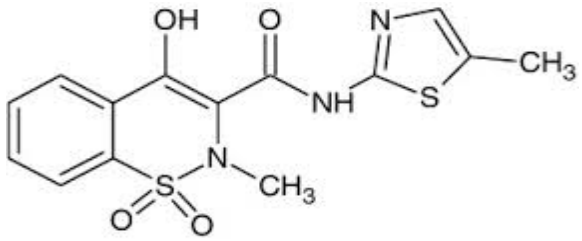

Figure1. Chemical structure of Meloxicam

Meloxicam is widely used in the treatment of rheumatoid arthritis, spondylitis, osteoarthritis, joint disease, in addition to its analgesic and antipyretic effect. It is also considered as a potential drug for the

prevention and treatment of colorectal polyps and/or cancer and also it is approved for the use in animals.[2, 3]

Literature survey revealed; Spectrophotometric, [4, 5] spectrophotometric and fluroimetry,[6] capillary zone electrophoresis,[7] voltametry,[8] calorimetric and FTIR, [9] liquid chromatography, [10] HPLC,[11-17] LC/MS, [18-20] flow-injection analysis, [21] NIR [22] and FTIR and UV-Vis [23] are reported for estimation of Meloxicam in pure and pharmaceutical dosage forms.

MATERIALS AND METHODS:

Materials:

Chemical and reagents:

Meloxicam was used as a standard. Ethanol as solvent [24, 25], all other chemical reagents and apparatus were of analytical grade.

Instrumentation and UV spectroscopy condition:

Agilent Carry 60 UV-Vis. Spectroscopy and 1 cm Quartz cells with a fixed slit width (2nm); the measurement properties wavelength range (200-800) nm, scan speed: 100nm/min, medium sampling interval: 2.0, scan mode: single, measuring mode: absorbance, digital electric balance.

Methods:

Standard solutions preparation:

Standard solution of Meloxicam was prepared by dissolving 50 mg of Meloxicam with ethanol in 50 ml volumetric flask, then diluting with ethanol up to the mark. Pipette out 5ml of stock solution and transfer into a 50 ml volumetric flask to dilute with ethanol 50 ml up to the mark.

Determination of Absorbance spectrum of Meloxicam:

Transfer 1 ml of standard solution into ethanol in 10 ml volumetric flask and dilute up to the mark. The resulted 10 µg/ml solution was measured at range (200- 400nm) using ethanol as blank, show the absorbance spectrum and λ_{max} at 365nm.

Preparation of Calibration curve:

From the sample solution, 100µg/ml resulting solution was prepared. From this 100 µg/ml solution (0.2-2.0 ml) was transferred to 10ml volumetric flasks and dilute with ethanol up to the mark. The method was determined at different concentration levels ranging (2-20µg/ml) for Meloxicam, the calibration curve was constructed by plotting absorbance versus concentration of Meloxicam (µg/ml) (Fig. 2).

Tablet 1: Standard solutions of Meloxicam (Concentration and Absorbance)

S. No.	Concentration (µg/ml)	Absorbance at 365nm
1	2	0.1124
2	4	0.1809
3	6	0.2892
4	8	0.3823
5	10	0.5203
6	12	0.5905
7	14	0.6986
8	16	0.7903
9	18	0.9043

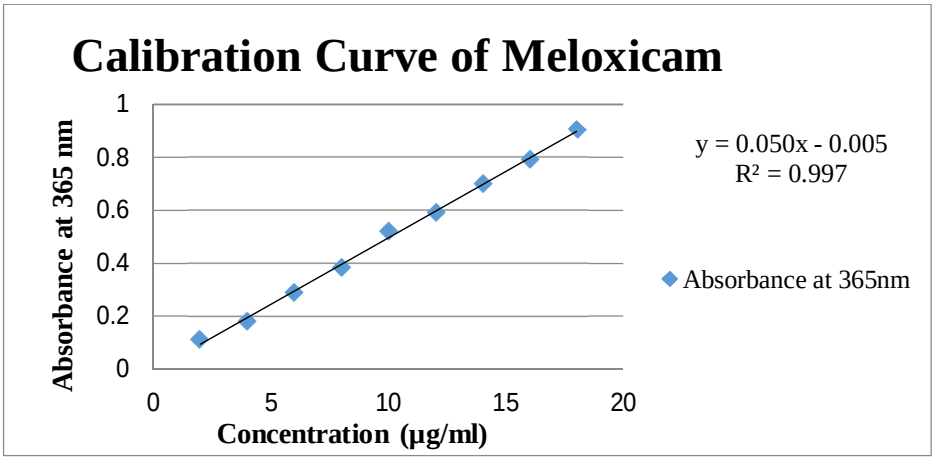

Figure 2: Calibration curve of Meloxicam

RESULT AND DISCUSSION [26- 28]

Linearity and Range:

The appropriate volume of the aliquot from the meloxicam standard stock solution was transferred to the volumetric flask of the 10 mL capacity. The volume was adjusted to the mark with ethanol. A calibration curve was plotted over a concentration range (2-18 µg/ml) of meloxicam. The absorbance of each solution was measured at 365 nm. The regression analysis was performed for line equation was found to be y=0.050x – 0.005 and correlation coefficient (R^2=0.997), the calibration curve was found to be linear in the above-stated concentration (Table 1) (Fig. 2).

Precision:

Repeatability

Aliquot stock solutions to further diluted with ethanol to get the solution of same concentration (4µg/ml). Resultant solutions were measured at 365nm using ethanol as blank (Table 2).

Table No. 2. Repeatability of Meloxicam

Nominal Conc. (µg/ml)	Absorbance	Observed Conc. (µg/ml)	Mean Conc. (µg/ml)	SD	%RSD
	0.1792	3.5			
	0.181	4.1			
	0.1793	3.5			
	0.1796	3.7			
4	0.181	4.1	3.77	6.3427	0.704
	0.1802	3.8			
	0.1798	3.7			
	0.1799	3.7			
	0.1806	3.9			

Intra-day Precision

It is evaluated by assaying sample solution prepared for assay determination 3 times on the same day Aliquot standard solution in volumetric flasks to further diluted with ethanol Resultant solutions were measured at 365nm using ethanol as blank (Table 3).

Table No. 3. Intra-day Precision of Meloxicam

Nominal Conc. (µg/ml)	Absorbance			Observed Conc. (µg/ml)			Mean Conc. (µg/ml)	SD	%RSD
	0hr	3hr	6hr	0hr	3hr	6hr			
4	0.1789	0.1776	0.1741	3.38	3.36	3.29	3.34	1.49	0.44
8	0.383	0.3824	0.3819	8.18	8.05	7.98	8.06	1.49	0.19
12	0.5906	0.5905	0.5897	12.05	12.01	11.57	11.87	2.95	0.25
								Mean	0.29

Inter-day Precision

It is evaluated by assaying 3 times of sample solution prepared for assay determination on 3 different days. The aliquot standard solution in volumetric flasks to further diluted with ethanol. Resultant solutions were measured at 365nm using ethanol as blank, 3 times on the same day (Table 4).

Table No. 4. Inter-day Precision of Meloxicam

Nominal Conc. (µg/ml)	Absorbance			Observed Conc. (µg/ml)			Mean Conc. (µg/ml)	SD	%RSD
	0hr	24hr	48hr	0hr	24hr	48hr			
4	0.1798	0.1792	0.1789	3.8	3.75	3.63	3.72	1.49	0.4
8	0.3825	0.3819	0.3814	8	7.9	7.7	7.86	5.97	0.76
12	0.591	0.5902	0.5998	12	12	11.9	11.96	13.49	1.13
								Mean	0.76

Accuracy:

The accuracy of the method was determined in terms of % recovery of standard, with no detectable impurities at an appropriate concentration. It was performed at three levels 80%, 100% and 120% by standard addition method.

Aliquots of stock solution were further diluted with ethanol and each concentration analyzed 3 times and average recoveries were measured at 365 nm using ethanol as blank (Table 5).

Table No. 5. Accuracy of Meloxicam

Recovery at (%)	Nominal Conc. (µg/ml)	Absorbance	Observed Conc. (µg/ml)	% Recovery
80	9=5+4	0.4498	8.88	98.67
80	9=5+4	0.4510	8.97	99.67
80	9=5+4	0.4508	8.92	99.11
100	10=5+5	0.5187	9.77	97.70
100	10=5+5	0.5154	9.74	97.40
100	10=5+5	0.5192	9.80	98.00
120	11=5+6	0.5489	10.85	98.64
120	11=5+6	0.5484	10.81	98.27
120	11=5+6	0.5595	10.87	98.81
			Mean	98.41±0.70

Specificity:

The specificity of the method for determination of meloxicam in tablet dosage form was determined by comparing the spectrum of tablet solution with that of standard solution. Aliquots of stock solution were further diluted with ethanol to get the solution of 10µg/ml concentration with and without excipients. The resultant solutions were measured at 365nm using ethanol as blank (table 6).

Table No. 6: Specificity of Meloxicam

Nominal Conc.(µg/ml)	Without Excipients		With Excipients		%Interference
	Absorbance	Observed Conc.(µg/ml)	Absorbance	Observed Conc.(µg/ml)	
10	0.4874	9.76	0.4964	9.94	1.84
10	0.4824	9.66	0.4864	9.74	0.82
10	0.4934	9.88	0.5023	10.06	1.82
10	0.4944	9.90	0.5003	10.02	1.21
10	0.4894	9.80	0.4944	9.90	1.02
10	0.4854	9.72	0.4939	9.89	1.74
				Mean	1.28

Table No. 7. Validation parameters of Meloxicam

S. No	Validation Parameters	Observation
1	**Range**	2-18 µg/ml
2	**Regression Equation**	y= 0.050x-0.005
3	**Correlation Coefficient**	0.997
4	**Precision (%RSD)**	
(i)	Repeatability	0.70
(ii)	Intra-Day Precision	0.29
(iii)	Inter-Day Precision	0.76
5	**Accuracy (% Recovery)**	98.41±0.70
6	**Specificity**	1.28

Determination of Meloxicam in API form:

Transfer 5mg of the drug to the volumetric flask of 50 mL capacity. The volume was adjusted to the mark with ethanol. Aliquot the solution was further diluted with ethanol to get the solution of 10µg/ml. The absorbance of the resultant solution was measured at 365nm using ethanol as blank. Each concentration analyzed 3 times [29] (Table 8).

Table No. 8. Determination in API

S. No.	Absorbance	Conc. (µg/ml)	Dil. Factor	Content (mg)	Weight Taken (mg)	%Assay
1	0.4874	9.76	5000	48.80	50.00	97.60
2	0.4914	9.84	5000	49.20	50.00	98.40
3	0.4839	9.69	5000	48.45	50.00	96.90
					Mean±SD	97.63±0.75

Determination of Meloxicam in Pharmaceutical dosage form (ECWIN, 15mg):

Weigh 20 tablets and calculates the average weight. Powder those tablets. Weigh accurately the quantity of powdered tablet containing about 50 mg of Meloxicam and transfer into 50 ml volumetric flask. Add 35 ml ethanol and sonication for 15 minutes. Make up the volume up to 50 ml, mix, and filter. Dilute 5 ml of the filtrate to 50 ml of ethanol. Further, dilute 1 ml of the resulting solution to 10 ml of ethanol. Measure the absorbance of the resulting solution at 365 nm (Table 9) [26-29].

Table No. 9. Determination of pharmaceutical dosage form

S. No.	Absorbance	Conc. (µg/ml)	Dil. Factor	Content (mg)	Weight Taken (mg)	Avg. Weight (mg)	Label Claim (mg)	%Assay
1.	0.4984	9.98	5000	49.90	293	88	15	99.87
2.	0.4934	9.88	5000	49.40	293	88	15	98.87
3.	0.4354	9.92	5000	49.60	293	88	15	99.27
							Mean±SD	99.34±0.50

CONCLUSION:

A simple and sensitive spectroscopy method for quantitative determination of Meloxicam in API form was developed. Meloxicam showed maximum absorbance at 365 nm in ethanol solution. It has a linear response in the entire range of (2-18µg/ml) with the correlation coefficient of 0.997. The linear regression equation obtained is y=0.050x -0.005. The method has the good precision within 2% and the average

accuracy as 98.41±0.70. No significant interference was observed in the absorbance of the drug in presence of common excipients.

Quantitative determination of Meloxicam in API as well as tablet dosage form by employed the method, the assay values found were 97.63±0.75 and 99.34±0.50 respectively.

In conclusion, the developed spectroscopy method is simple, accurate and precise and can be used for routine analysis of Meloxicam in either API or in tablet dosage form.

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