

**SPECTROPHOTOMETRIC AND STABILITY-INDICATING  
SPECTROPHOTOMETRIC METHODS FOR DETERMINATION OF  
LORNOXICAM IN PURE FORM AND PHARMACEUTICAL  
PREPARATION.**

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**ABSTRACT**

Four Simple, rapid, sensitive, accurate and precise methods were developed for the determination of lornoxicam in bulk powder, in pharmaceutical preparation and in presence of its degradate. Method (A) ratio difference method; is based on measuring the difference in the amplitude of intact lornoxicam in presence of its degradation product at two different wavelengths, this is done at 233.8 nm and

249.4 nm in the range of 5 – 35  $\mu\text{g ml}^{-1}$  with LOD of 0.136  $\mu\text{g ml}^{-1}$  and LOQ of 0.453  $\mu\text{g ml}^{-1}$ . Method (B) mean centering method; the method was applied for the analysis of lornoxicam in presence of its acidic degradation product this is done at 243.8 nm in the range of 5 – 35  $\mu\text{g ml}^{-1}$  with LOD of 0.072  $\mu\text{g ml}^{-1}$  and LOQ of 0.241  $\mu\text{g ml}^{-1}$ . Method (C) o-phenanthroline-Fe (III) mixture; upon reacting o-phenanthroline-Fe (III) with lornoxicam, Fe (III) is reduced to Fe (II) which form a red complex with O-phenanthroline this is done at 512 nm in the range of 0.8 – 5.6  $\mu\text{g ml}^{-1}$  with LOD of 0.010  $\mu\text{g ml}^{-1}$  and LOQ of 0.034  $\mu\text{g ml}^{-1}$ . Method (D) oxidative coupling with 3-methylbenzothiazoline-2-one hydrazone (MBTH); the reaction of lornoxicam with MBTH in presence of oxidizing agent (ceric ammonium sulphate) proceeds via oxidative coupling to form an orange colored product measured at 456 nm in the range of 3-18  $\mu\text{g ml}^{-1}$  with LOD of 0.199  $\mu\text{g ml}^{-1}$  and LOQ of 0.664  $\mu\text{g ml}^{-1}$ . The obtained results were statistically compared with those of the reported method by applying t-test and

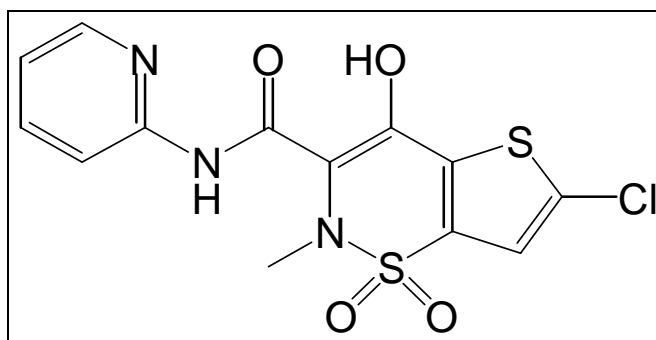
F-test at 95% confidence level and no significant difference was observed regarding accuracy and precision.

**KEY WORDS:** Lornoxicam, Ratio difference, Mean centering, O-phenanthroline, MBTH.

## INTRODUCTION

Lornoxicam (Fig. 1) is 6-Chloro-4-hydroxy-2-methyl-N-2-pyridyl-2H-thieno[2,3-e][1,2]-thiazine-3-carboxamide 1,1-dioxide<sup>[1]</sup>, is a yellow powder slightly soluble in chloroform and 0.1 M sodium hydroxide, very slightly soluble in methanol and acetonitrile, and hardly soluble in water<sup>[2]</sup>.

Literature survey shows that several spectrophotometric<sup>[3-13]</sup>, spectrofluorimetric<sup>[14-16]</sup>, voltametric assay<sup>[17-18]</sup> and chromatographic<sup>[19-29]</sup> methods for determination of lornoxicam in pure form, pharmaceutical preparations and/or biological fluids have been reported.



**Figure 1: Structural formula of Lornoxicam**

Under computer-controlled instrumentation, ratio difference method and mean centering method are playing a very important role in the analysis of lornoxicam in presence of its degradation product without previous separation by UV–VIS spectrophotometry<sup>[30-32]</sup>. In this work, both O-phenanthroline method<sup>[33-35]</sup> and MBTH method<sup>[36-38]</sup> were applied for colorimetric determination of lornoxicam. The proposed procedures were successfully applied for determination of the studied drug in bulk powder and in pharmaceutical dosage form.

## MATERIALS AND METHODS

### Apparatus

- Shimadzu UV-Vis. 1650 Spectrophotometer ( Japan ).
- Hot plate ( Torrey pines Scientific, USA ).
- Jenway, 3510 pH meter ( Jenway, USA ).

## MATERIALS AND REAGENTS

### Pure sample

Lornoxicam; was kindly supplied by multi-apex company, Egypt, B. No.(08901732).

### Pharmaceutical preparation

XEFO<sup>®</sup> 8mg Tablets: product of Nycomed company, Egypt, Batch No. (MT2070512), labeled to contain 8 mg of Lornoxicam per tablet purchased from local pharmacies.

### Reagents and solvents

All chemicals and reagents used throughout the work were of analytical grade.

- Water used throughout the procedures was freshly double distilled.
- Methanol (Sigma–Aldrich, USA).
- Ammonium ferric sulphate (Merck, Germany).
- Glacial acetic acid (Fisher Scientific, U.S.A.).
- 1, 10- O-phenanthroline (Loba Chemie, Mobaai, India).
- Ammonium acetate, Hydrochloric acid, Sodium acetate anhydrous.
- Dimethyl sulfoxide:(Morgan Chemicals Co., Egypt).
- 1M hydrochloric acid aqueous solution.
- Acetate buffer solution ( pH 2.5 - 6) <sup>[39]</sup>, prepared by dissolving 10 gm of sodium acetate anhydrous in 300 ml water, adjusting the pH with glacial acetic acid and diluting to 1000 ml with water.
- O-phenanthroline –Fe (III) mixture <sup>[40]</sup>, prepared by dissolving 0.5 gm of O-phenanthroline monohydrate and 0.4 gm of ammonium ferric sulfate in 5 ml of 1M hydrochloric acid then diluting to 250 ml with water. This solution is stable for one month if stored in refrigerator.
- MBTH solution :(Sigma Aldrich,Germany),0.4% , $4.034 \times 10^{-4}$  M and  $1.34 \times 10^{-4}$  M , aqueous solution.
- Acetonitrile: (El-Nasr- Company, Egypt).
- Sulphuric acid: (Merck-Germany),5% aqueous solution.
- Ferric ammonium sulphate :(BDH Chemicals Ltd Poole,England ) 0.1% in 5% H<sub>2</sub>SO<sub>4</sub>.

### Standard solutions

- For method (A&B): Stock solution of lornoxicam ( $0.1 \text{ mg ml}^{-1}$ ) was prepared by dissolving 10 mg of lornoxicam in 100 ml methanol and this is the working standard solution.
- For method (C): Stock solution of lornoxicam ( $0.1 \text{ mg ml}^{-1}$ ) was prepared by dissolving 10 mg powder in 50 ml dimethyl sulfoxide(DMSO) and complete the volume to 100ml with dimethyl sulfoxide (DMSO). The working standard solution ( $0.04 \text{ mg ml}^{-1}$ ) was prepared by dilution of the stock solution with DMSO.
- For method (D): Standard solution of lornoxicam ( $0.1 \text{ mg ml}^{-1}$ ) was prepared in a 100 ml volumetric flask by dissolving 10 mg powder in acetonitrile solution .

### Degraded sample <sup>[26]</sup>

Methanolic solution of lornoxicam (10 mg in 10 ml methanol) was mixed in 10 mL of 1M HCl and this solution was kept for 8 h at room temperature in dark in order to exclude the possible degradative effect of light. The solution was then neutralized to pH 7 by addition of 0.1 M NaOH, evaporated to dryness , the residue was extracted three times with 25 ml methanol,filtered into 100 ml volumetric flask then the volume was adjusted by the same solvent.The obtained solution was claimed to contain( $0.1 \text{ mg ml}^{-1}$ ).

### Procedures

#### Construction of the calibration curve (General procedure)

##### a. Ratio difference method

Aliquots equivalent to (0.05 – 0.35 mg) of lornoxicam working standard solution were accurately transferred into a series of 10 - ml volumetric flasks then completed to volume with methanol. The spectra of the prepared standard solutions are scanned from 200 - 400 nm using methanol as a blank and stored in the computer.The absorption spectra of lornoxicam are divided by the spectrum of ( $15 \text{ } \mu\text{g ml}^{-1}$ ) of the acidic degradate. The amplitude difference at 233.8 and 249.4 nm ( $\Delta P_{233.8-249.4}$ ) was plotted against the corresponding lornoxicam concentration in  $\mu\text{g ml}^{-1}$  and the regression equation was computed.

##### b. Mean centering method

Aliquots equivalent to (0.05 – 0.35 mg) of lornoxicam working standard solution were accurately transferred into a series of 10 - ml volumetric flasks then completed to volume with methanol. The spectra of the prepared standard solutions are scanned from 200 - 400 nm

using methanol as a blank and stored in the computer. The absorption spectra of lornoxicam are divided by the spectrum of ( $15 \mu\text{g ml}^{-1}$ ) of the acidic degradate. The amplitude of the mean centered peak of (intact / degradate) is measured at 243.8 nm. A calibration graph relating the peak amplitude to the corresponding concentrations in  $\mu\text{g ml}^{-1}$  of lornoxicam was constructed.

#### **c. O-phenanthroline method**

Into a series of 20 ml test tubes, aliquots of lornoxicam working standard solution ( $0.04 \text{ mg ml}^{-1}$ ) containing (0.008 – 0.056 mg) were introduced followed by the addition of 3.5 ml of O-phen-Fe (III) mixture and 2.5 ml of acetate buffer pH 4.5 to each tube. The tubes were mixed well and heated in a boiling water bath for 40 minutes. Then cooled, transferred quantitatively into a series of 10 ml volumetric flasks and diluted to volume with water. The absorbance of the developed orange-red color was measured at 512 nm against a reagent blank. Calibration curve relating the absorbance to drug concentration in  $\mu\text{g ml}^{-1}$  was constructed.

#### **d. MBTH method**

Aliquots of lornoxicam working standard solution equivalent to (30-180  $\mu\text{g}$ ) were transferred into a series of 10 ml volumetric flasks followed by 1 ml of 0.4 % MBTH solution and 3 ml of 0.1% ferric ammonium sulphate. The solutions were mixed and allowed to stand at room temperature for 20 minutes. Volumes were adjusted with acetonitrile to the mark and the absorbance of the developed orange color was measured against reagent blank at 456 nm. Calibration curve relating the absorbance to drug concentration in  $\mu\text{g ml}^{-1}$  was constructed.

### **Analysis of pharmaceutical preparation**

#### **- For ratio difference and mean centering methods**

Ten Xefo<sup>®</sup> 8 mg tablets were accurately weighed and finely powdered, then a quantity equivalent to 10 mg of lornoxicam was shaken three times with 25 ml methanol 10 minutes then filtered into 100 ml volumetric flask and the volume was adjusted to the mark with methanol to obtain a concentration of ( $0.1 \text{ mg ml}^{-1}$ ). Proceed as described under “General Procedure” for each method.

#### **-For O-phenanthroline method**

An accurately weighed quantity of the well-mixed powdered Xefo 8 mg<sup>®</sup> tablets equivalent to 10 mg of lornoxicam was shaken with 90 ml DMSO, filtered and the final volume was

completed with DMSO to 100 ml. The obtained solution of lornoxicam ( $0.1 \text{ mg ml}^{-1}$ ) was subjected to colorimetric determination as detailed under "General Procedure".

#### **-For MBTH method**

An accurately weighed quantity of the well-mixed powdered tablets equivalent to 10 mg of lornoxicam was shaken with 90 ml of acetonitrile then filtered into 100 ml volumetric flask and the volume was completed to 100 ml with acetonitrile. The obtained solution ( $0.1 \text{ mg ml}^{-1}$ ) was analyzed as detailed under "General Procedure". Determine the content of the tablets either from the calibration curve or using the corresponding regression equation.

## **RESULTS AND DISCUSSION**

### **Spectral characteristics and optimization of the methods**

#### **Ratio difference method**

The zero-order absorption spectra of lornoxicam (Fig.2) show an overlapping, so we develop a spectrophotometric method which allow the determination of the drug in presence of its degradate without previous separation.

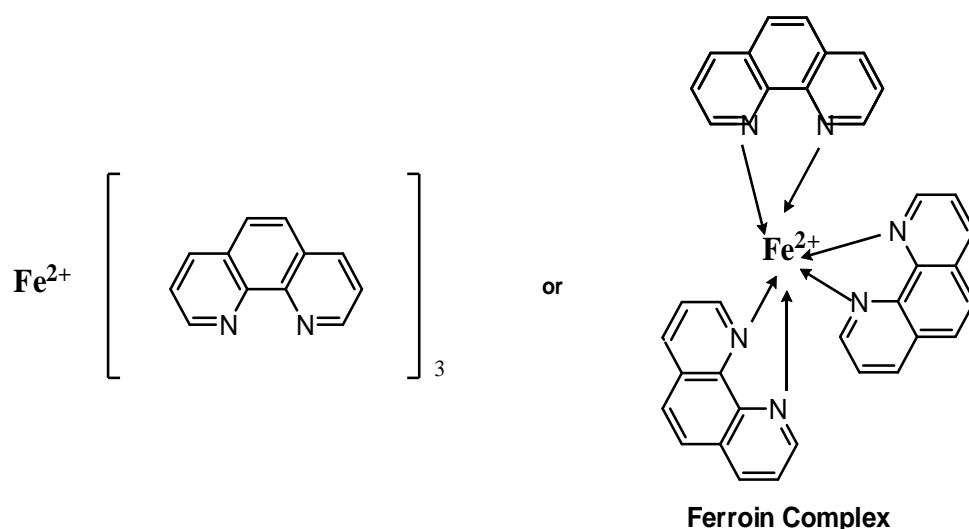
In this method, the absorption spectra of the drug were divided by a suitable absorption spectrum of the interfering drug (divisor) to get the ratio spectra. The difference in peak amplitudes between two selected wavelengths in the ratio spectra is proportional to the concentration of the drug without interference from its divisor, as shown in Fig. 3. The method comprises two critical steps, the first is the choice of the divisor. The selected divisor should compromise between minimal noise and maximum sensitivity. The best divisor concentration was  $15 \mu\text{g/ml}$  of lornoxicam degradate. The second critical step is the choice of the wavelengths at which measurements are recorded. Any two wavelengths can be chosen provided that they exhibit different amplitudes in the ratio spectrum and good linearity is present at each wavelength individually. The selected wavelengths are 233.8 and 249.4 nm ( $\Delta P_{233.8-249.4 \text{ nm}}$ ) which gave the best results.

#### **Mean centering method**

In this method, the absorption spectra of the drug were divided by a suitable absorption spectrum of the interfering drug (divisor) to get the ratio spectra (Fig.3). The best divisor concentration was  $15 \mu\text{g/ml}$  of lornoxicam degradate. The obtained ratio spectra were mean centered using MATLAB and the concentration of lornoxicam was determined by measuring the amplitude at 243.8 nm (Fig. 4).

### O-phenanthroline method

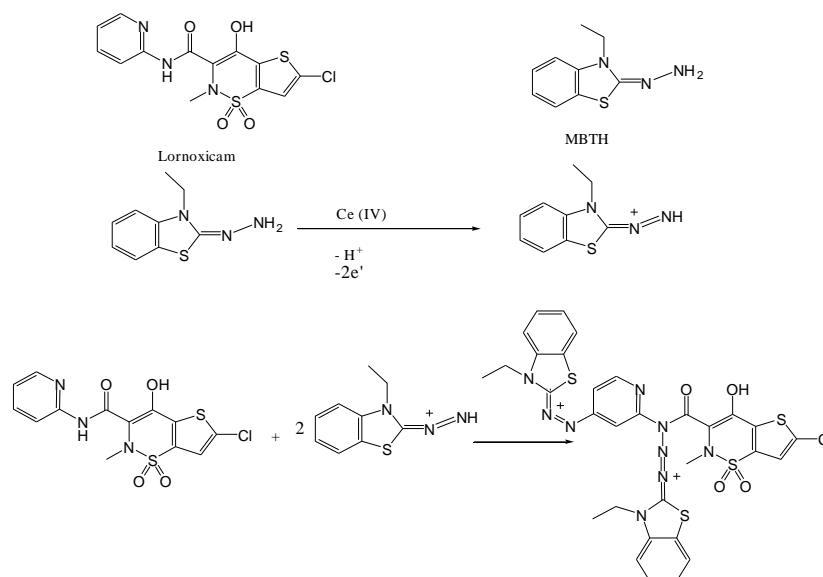
Under the optimum conditions, a red colored complex was formed, that exhibited an absorption maximum at 512 nm, (Fig.5). This method depends on the reducing action of lornoxicam on Fe (III) which is reduced to Fe(II), the latter reacts with O-phenanthroline to give a red colored complex that exhibited an absorption maximum at 512 nm. The structure of the formed complex is shown in the following scheme:



Different parameters affecting the reaction were optimized with regard to the effect of pH, volume of buffer solution, volume of reagent mixture and the effect of heating time. It was found that 2.5 ml of acetate buffer pH 4.5, 3.5 ml of reagent mixture, [O-phen -Fe (III)], and boiling were necessary for complete reaction. The maximum absorbance was reached after heating for 40 minutes on a boiling water bath, the color remained stable for further one hour after cooling, (Fig.6-10).

### MBTH method

Upon reacting lornoxicam with MBTH reagent in the presence of ceric ammonium sulphate, an orange colored product was formed and exhibited absorption maxima at 456 nm (Fig.11). MBTH reagent can react with carbonyl derivatives through its hydrazone grouping. On the other hand, it forms a strongly electrophilic diazonium salt when acted upon by an oxidizing agent. This diazonium salt can couple with various compounds. It can react with lornoxicam as shown in the following <sup>(41)</sup> scheme:

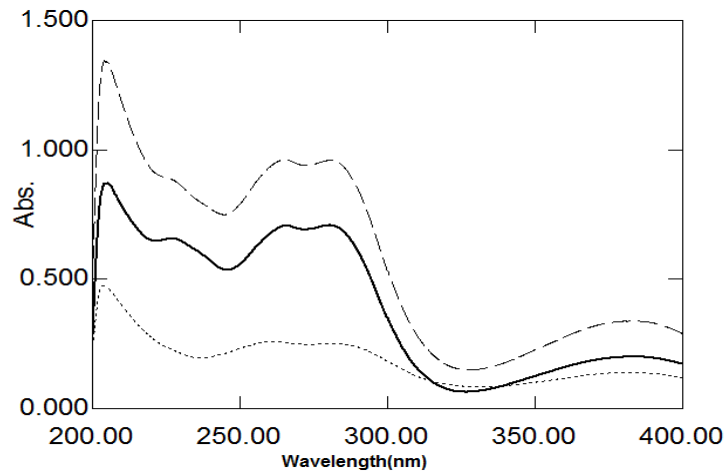


Different factors affecting the reaction were studied. These include volumes of MBTH reagent, 0.1% ceric ammonium sulphate and stability of the color. It was found that 1 ml of 0.4% MBTH reagent was sufficient to give maximum absorbance (Fig.12). Also, 3 ml of 0.1% ceric ammonium sulphate solution was found to be the most suitable volume that gave the maximum color intensity (Fig.13).

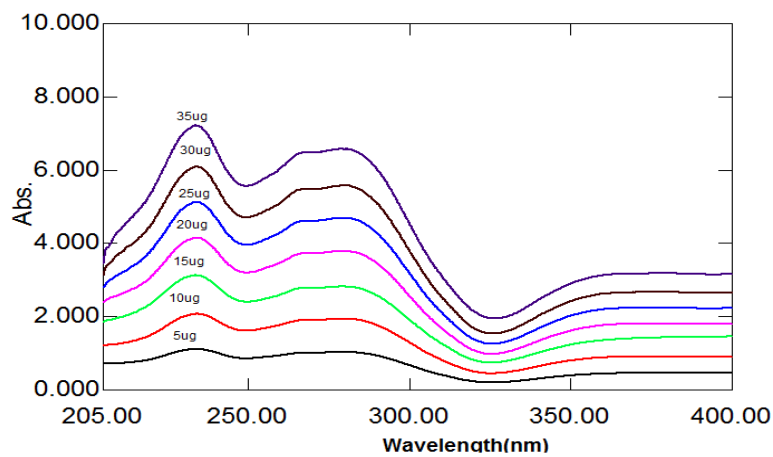
The intensity of color reaches maximum at room temperature after 20 minutes, and the developed color was stable for at least one hour (Fig.14). The order of addition of the reagents is an essential part of the experiment, addition of MBTH solution after ceric ammonium sulphate produces the lowest absorbance reading. Effect of temperature on the development of the color was studied by heating the reaction solution in thermostatically-controlled water bath. Different temperature settings were used with constant heating time. Increasing the temperature of the water bath, was found to produce decrease in color till it disappeared completely upon boiling, therefore, the reaction was conducted at room temperature. The optimum concentration of  $H_2SO_4$  in which ceric ammonium sulphate was dissolved was found to be 5%. Higher concentrations did not affect the color intensity.

Molar ratio and continuous variation (Job's) methods were adopted to assess the stoichiometry of the reaction and it was noted that, lornoxicam interacts with MBTH reagent on bimolecular basis quantitative analysis (1 : 2), figures (15,16), respectively.

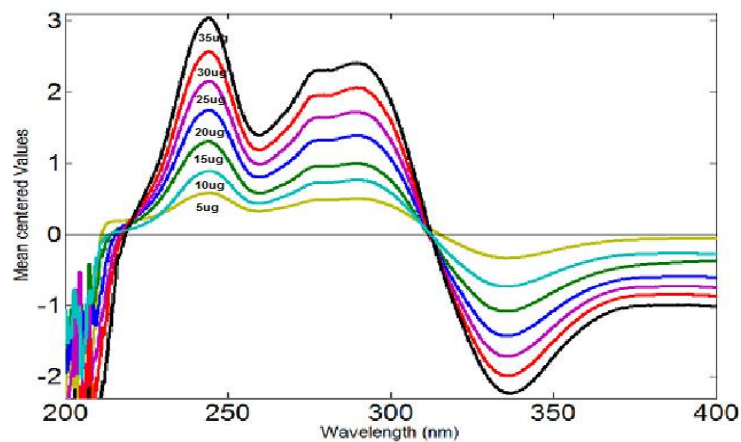




**Figure (2): UV- Spectra of Intact Lornoxicam ( 15µg ml<sup>-1</sup>)(—), Degradate Lornoxicam ( 15 µg ml<sup>-1</sup>)(.....)and their mixture( 15 µg ml<sup>-1</sup>for each) (— —).**



**Figure (3): Ratio Spectra of Lornoxicam (5 – 35 µg ml<sup>-1</sup>) using(15 µg ml<sup>-1</sup>) of Acidic Degradate as a Divisor and Methanol As Blank**



**Figure (4): Mean Centered Ratio Spectra of Lornoxicam (5 – 35 µg ml<sup>-1</sup>) Using ( 15 µg ml<sup>-1</sup>) of its Acidic Degradate as a Divisor and Methanol as Blank.**

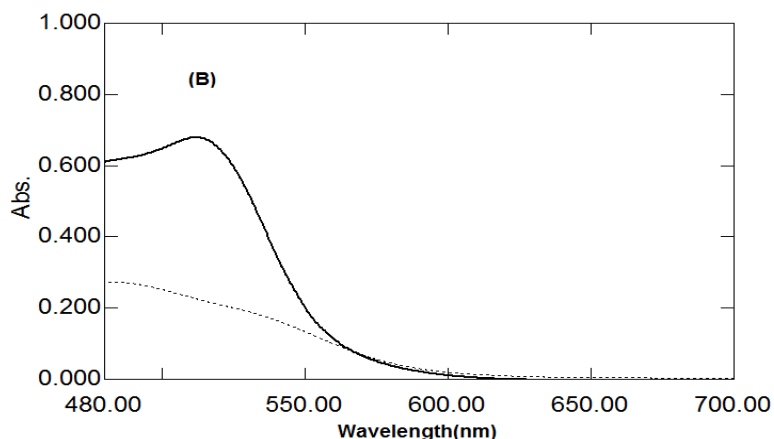


Figure (5): Absorption spectra of lornoxicam reaction product with o-phen – Fe(III) mixture (—) and the reagent only (.....) (B).

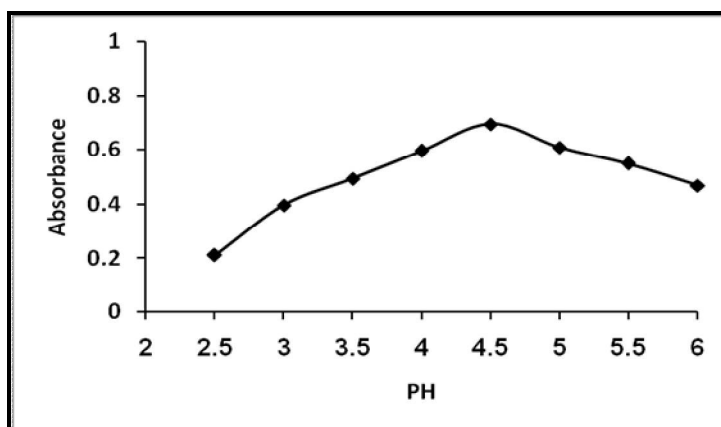


Figure (6): Effect of pH on the absorbance of lornoxicam ( $4 \mu\text{g ml}^{-1}$ ) reaction product with O-phen-Fe(III) mixture at 512 nm.

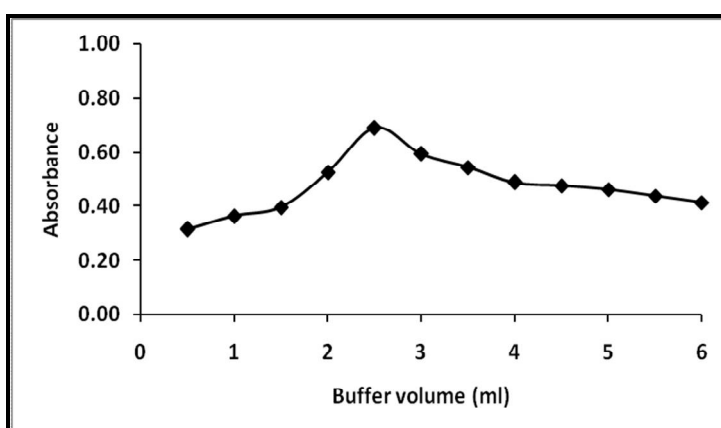


Figure (7): Effect of acetate buffer volume on the absorbance of lornoxicam ( $4 \mu\text{g ml}^{-1}$ ) reaction product with O-phen-Fe(III) mixture at 512 nm.

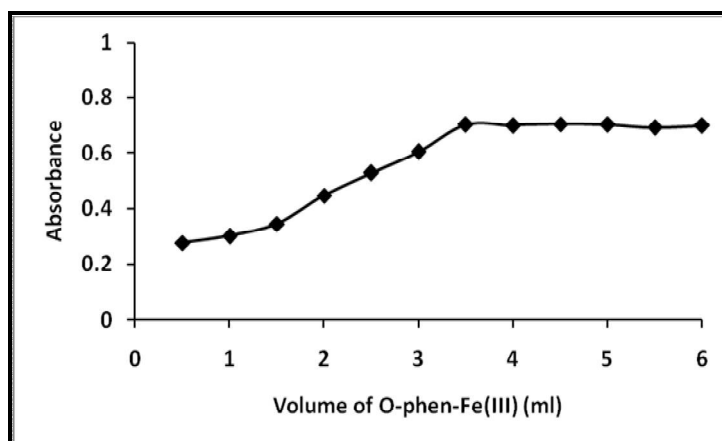


Figure (8): Effect of O-phen-Fe(III) mixture volume on the absorbance of its reaction product with lornoxicam ( $4 \mu\text{g ml}^{-1}$ ) at 512 nm.

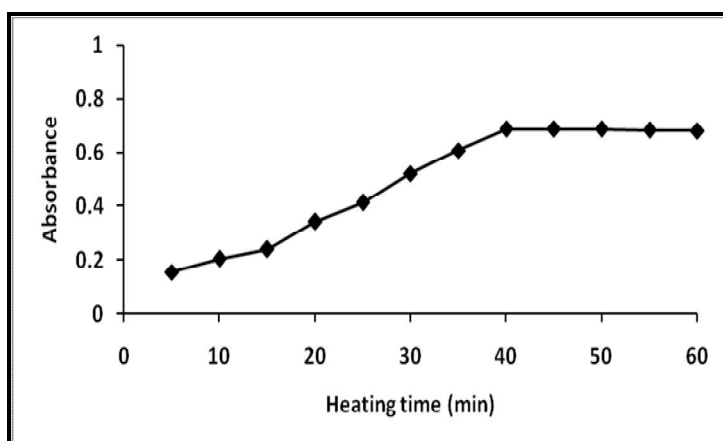


Figure (9): Effect of heating time at 100 °C on the absorbance of lornoxicam ( $4 \mu\text{g ml}^{-1}$ ) reaction product with O-phen-Fe(III) mixture at 512 nm.

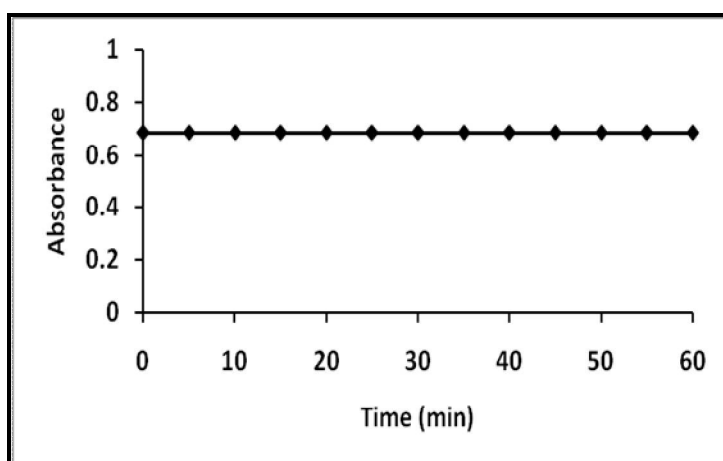


Figure (10): Effect of time on the colour stability of lornoxicam ( $4 \mu\text{g ml}^{-1}$ ) reaction product with O-phen-Fe(III) mixture at 512 nm.

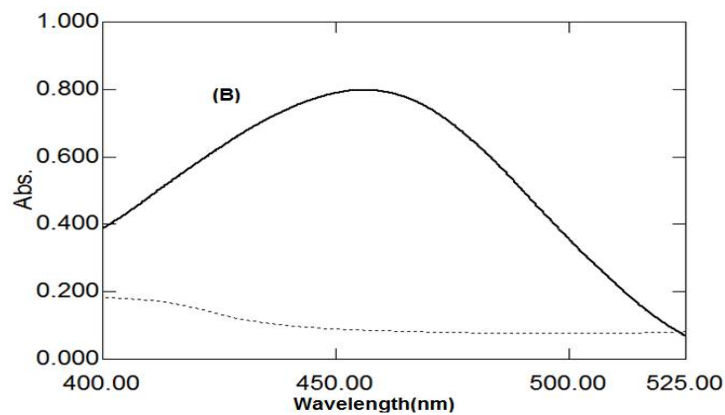


Figure (11): Absorption spectra of lornoxicam reaction product with MBTH reagent (—) and the reagent only (.....)(B).

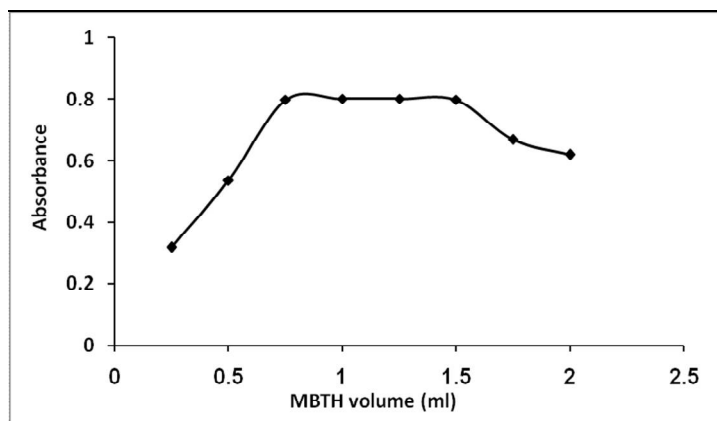


Figure (12): Effect of volume of 0.4% MBTH reagent on the absorbance of lornoxicam (15 µg/ml) at 456 nm.

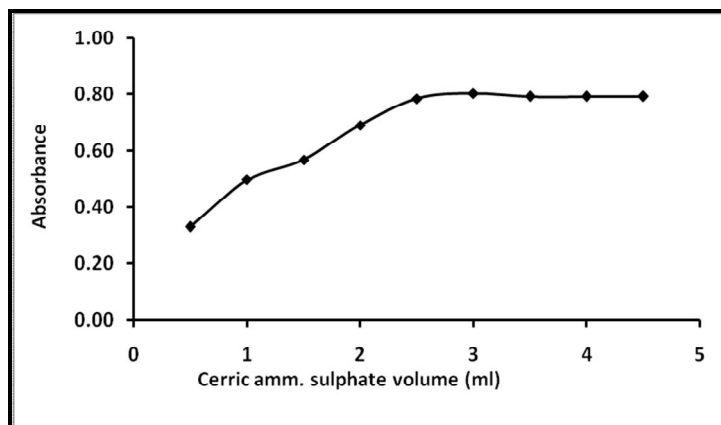


Figure (13): Effect of volume of 0.1% ceric ammonium sulphate on the absorbance of lornoxicam (15 µg/ml) with MBTH reagent at 456 nm.

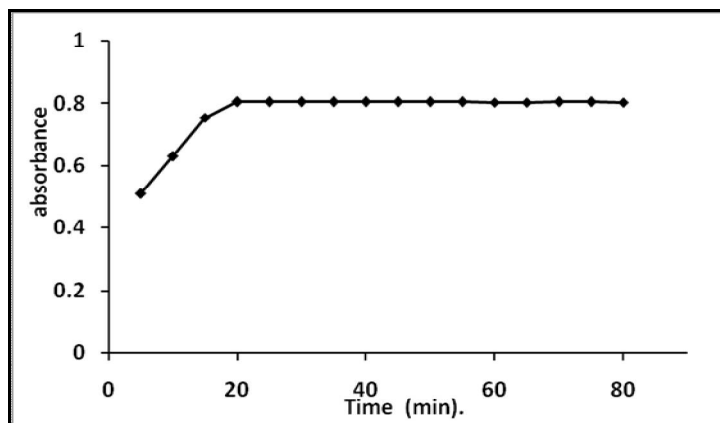
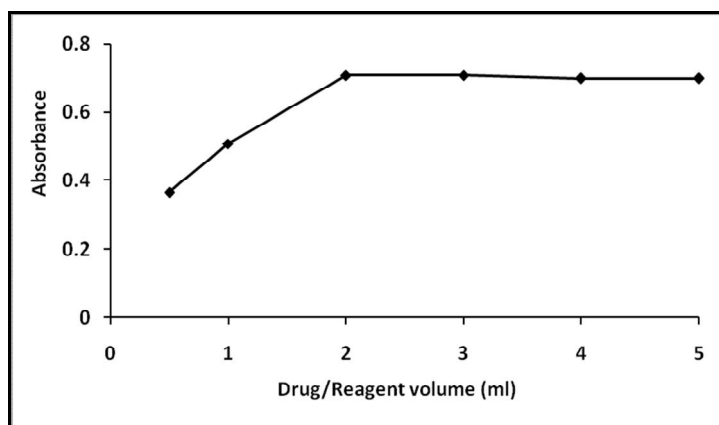
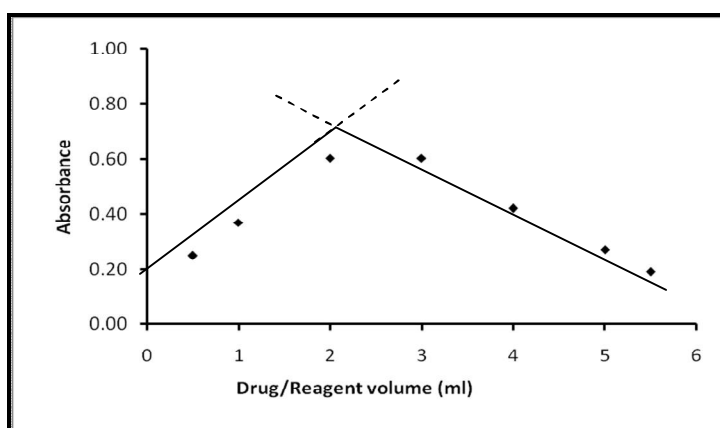


Figure (14): Effect of time on the absorbance of lornoxicam (15 µg/ml) with MBTH reagent at 456 nm.



Figure(15): The Stoichiometry of the Reaction Between lornoxicam ( 4.034 x 10<sup>-4</sup> M) and MBTH reagent by The Molar Ratio Method at 456 nm.



Figure(16): Stoichiometry of the reaction of Lornoxicam ( 1.34 x 10<sup>-4</sup> M) with MBTH reagent by Continuous Variation (Job's) method at 456 nm.

## Validation of the methods

### Linearity and range

**-For ratio difference method:** Linear correlation was obtained between the differences in amplitudes at 233.8 and 249.4 nm, against the corresponding concentration of lornoxicam. Good linearity is obtained in the concentration range of 5 - 35  $\mu\text{g ml}^{-1}$  lornoxicam. The corresponding regression equation was computed to be:

$$\Delta P_{233.8 - 249.4} = 0.046 C + 0.013 \quad (r^2 = 0.9997)$$

Where  $\Delta P$  is the amplitude difference at the selected wavelengths, C is the concentration in  $\mu\text{g ml}^{-1}$  and  $r^2$  = the correlation coefficient as shown in table 1.

**-For mean centering method:** Linear correlation was obtained between the mean centered values at 243.8 nm, against the corresponding concentration of lornoxicam. Good linearity is obtained in the concentration range of (5 - 35  $\mu\text{g ml}^{-1}$ ) lornoxicam. The corresponding regression equation was computed to be:

$$\text{MCN}_{243.8} = 0.083 C + 0.069 \quad (r^2 = 0.9998)$$

Where MCN is the peak amplitude of the mean centered ratio spectrum curve, C is the concentration in  $\mu\text{g ml}^{-1}$  and  $r^2$  = the correlation coefficient, as shown in table 1.

**-For O-phenanthroline method:** Under the described experimental conditions, linear relationship between absorption and concentration was obtained at the range of (3-18  $\mu\text{g ml}^{-1}$ ) . The linear regression equation for the graph was:

$$A_{456} = 0.05319 C + 0.00629 \quad (r^2 = 0.9998)$$

Where A is the absorbance and C is the drug concentration in  $\mu\text{g ml}^{-1}$ , as shown in table 1.

**-For MBTH method:** Under the experimental conditions described, Beer's law was obeyed in the range of (0.8-5.6  $\mu\text{g ml}^{-1}$ ) . The linear regression equation for graph is:

$$A_{747} = 0.1754 C + 0.00162 \quad (r^2 = 0.9998).$$

Where, A is the absorbance, C is the drug concentration in  $\mu\text{g ml}^{-1}$  as shown in table 1.

### Limits of detection and quantitation

The limit of detection (LOD) and the limit of quantitation (LOQ) were calculated according to ICH guidelines<sup>[42]</sup> from the following equations:

$$\text{LOD} = 3.3 S_a / \text{slope}$$

$$\text{LOQ} = 10 S_a / \text{slope}$$

Where  $S_a$  is the standard deviation of y-intercepts of regression lines.

LOD and LOQ values of lornoxicam for each method were listed in table 1. The small values of LOD and LOQ indicate good sensitivity.

### Accuracy and precision

According to the ICH guidelines <sup>[42]</sup>, three replicate determinations of three different concentrations of the studied drugs in pure form within their linearity ranges were performed in the same day (intra-day) and in three successive days (inter-day) for each method. Accuracy as recovery percent (R%) and precision as percentage relative standard deviation (RSD%) were calculated and results are listed in table 2. The small values of RSD% indicates high precision of the methods. Moreover, the good R% confirms excellent accuracy.

### Specificity (for ratio difference and mean centering methods)

The specificity of the proposed methods were assured by applying the laboratory prepared mixtures of the studied drug and its degradate. The results are listed in table 3.

### Pharmaceutical Applications

The proposed methods were applied to the determination of the studied drug in **XEFO**® tablets. The results were validated by comparison to a previously reported method <sup>[43]</sup>. No significant differences were found by applying t-test and F-test at 95% confidence level <sup>[44]</sup>, indicating good accuracy and precision of the proposed methods for the analysis of the studied drugs in their pharmaceutical dosage form (table 4).

**Table (1): Spectral data for determination of the studied drugs by the proposed methods**

Parameters	Ratio difference	Mean centering	O-phenanthroline	MBTH
Wavelength (nm)	233.8&249.4	243.8	512	456
Linearity range ( $\mu\text{gml}^{-1}$ )	5-35	5 — 35	0.8 — 5.6	3 — 18
LOD ( $\mu\text{gml}^{-1}$ )	0.136	0.072	0.010	0.199
LOQ ( $\mu\text{gml}^{-1}$ )	0.453	0.241	0.034	0.664
Regression equation*				
Slope ( <i>b</i> )	0.046	0.083	0.17	0.05319
Intercept ( <i>a</i> )	0.013	0.069	0.001	0.00629
Correlation coefficient ( $r^2$ )	0.9997	0.9998	0.9999	0.9998

\*  $y = a + bx$  where  $y$  is the response and  $x$  is the concentration.

**Table (2): Intraday and interday accuracy and precision for the determination of the lornoxicam by the proposed methods**

Method	Conc $\mu\text{g}\cdot\text{ml}^{-1}$	Intraday			Interday		
		Found Conc. + SD	Accuracy (R%)	Precision (RSD%)	Found Conc. + SD	Accuracy (R%)	Precision (RSD%)
Ratio difference	10	9.82±0.005	98.19	1.062	9.80±0.004	98.04	0.939
	15	15.28±0.009	101.84	1.379	15.27±0.010	101.79	1.414
	20	20.29±0.009	101.45	0.976	20.36±0.008	101.78	0.845
Mean centering	10	9.85±0.002	98.45	0.181	9.81±0.002	98.13	0.259
	15	14.88±0.006	99.21	0.454	14.79±0.013	98.59	0.983
	20	20.08±0.011	100.40	0.608	20.14±0.014	100.69	0.829
O-phenanthroline	2.4	2.4 ± 0.002	100	0.490	2.38 ± 0.004	99.02	0.988
	3.2	3.19 ± 0.003	99.82	0.490	3.19 ± 0.003	99.82	0.486
	4	4.02 ± 0.003	100.54	0.370	3.99 ± 0.006	99.85	0.819
MBTH	12	11.99 ± 0.005	99.90	0.700	12.06 ± 0.005	100.47	0.710
	15	15.1± 0.007	100.67	0.830	15.13± 0.005	100.88	0.619
	18	18.08±0.007	100.45	0.730	18.17± 0.004	100.94	0.413

**Table (3): Determination of the lornoxicam and its degradate in their laboratory mixtures by ratio difference and mean centering methods.**

	Intact in ( $\mu\text{g ml}^{-1}$ )	Degradate in ( $\mu\text{g ml}^{-1}$ )	Percent of degradate	Intact found in ( $\mu\text{ ml}^{-1}$ )	Recovery % of intact
Ratio difference	30	5	14.29	30.12	101.13
	25	10	28.57	24.80	101.16
	20	15	42.86	19.96	99.80
	15	20	57.14	15.17	99.40
	10	25	71.43	10.11	99.18
	Mean ± SD%				



Mean centering	30	5	14.29	29.46	98.20
	25	10	28.57	24.67	98.70
	20	15	42.86	19.86	99.32
	15	20	57.14	14.95	99.69
	10	25	71.43	10	99.96
	Mean $\pm$ SD%				

**Table (4): Determination of lornoxicam in XEFO<sup>®</sup> tablets by the proposed and reported methods**

	Ratio difference	Mean centering	O-phenanthroline	MBTH	Reported method <sup>[43]</sup>
<b>N*</b>	7	7	7	6	7
<b>X̄</b>	100.01	99.72	99.75	99.92	99.55
<b>SD</b>	0.799	0.572	0.720	0.550	0.460
<b>RSD%</b>	0.799	0.573	0.720	0.550	0.460
<b>t**</b>	1.32 (1.782)	0.614 (1.782)	0.619 (1.782)	1.303 (1.7959)	—
<b>F**</b>	1.31 (4.28)	1.535 (4.28)	0.410 (4.28)	0.699 (4.95)	—

\* No. of experimental.

\*\* The values in the parenthesis are tabulated values of t and F at (p= 0.05).

## CONCLUSION

The proposed methods are simple, rapid, accurate and precise and can be used for the determination of lornoxicam in pure form and in pharmaceutical dosage form.

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