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UV- Spectral Studies on Chlorpheniramine Maleate In Pure Form And Pharmaceutical Preparations

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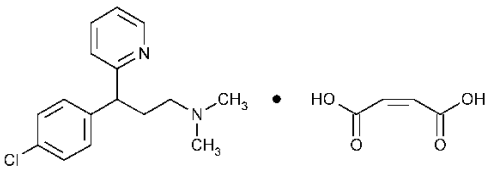
Abstract:

A simple, fast, sensitive, and accurate spectrophotometric method has been developed for the determination of Chlorpheniramine maleate (CPM) in pure and pharmaceutical dosage forms, The quantitative determination of the drug applied used Zero-crossing order, third-order, and fourth-order derivative which measured at 262 nm,270 nm, and 264nm respectively. The methods obey Beers-Lambert law in the concentration range (1.95-39.07)µg/ml with a relative standard deviation RSD equal to 0.51% for the zero-order and 0.16% for the third-order and 1.94% for the fourth-order when the determination range was (1.95-7.81)µg/ml for the third- order with RSD equal to 1.37% for the integrated area under the positive peak, The developed spectrophotometric method in this study is successfully applied for the direct determination of the pharmaceutical form Histamine, The percentages recoveries were (96-98.6)% for the zero-order, (96.3-103.8) % for the third-order and (96.7-101.6) % for the fourth-order, this method is easy and economical and doesn't require the use of any expensive or toxic reagent; these advantages make it suitable for routine quality control.

Keywords: Spectrophotometry, Chlorpheniramine Maleate, Zero-crossing order, Third-order, Fourth order.

1. Introduction

Chlorpheniramine maleate (CPM) chemically 3-(4-chlorophenyl) –N, N-dimethyl-3-pyridine-2-yl-propan-1-amine is a synthetic alkylamine derivative used in pharmaceutical preparations for symptomatic relief of common cold and allergic diseases [1] such as rhinitis and urticaria.



Fig(1) Chemical structure of CPM.

Histamine drug is primarily composed of CPM which is one of the antihistamines that stop the action of histamine, either by blocking histamine receptors or by stopping the manufacture of histamine. Many methods have been reported for the direct determination of CPM in pharmaceutical preparations, including high-performance liquid chromatography procedures coupled with different types of ultraviolet mass spectrometry detectors [2-8] a micellar electrokinetic chromatography method has been used for the simultaneous determination of paracetamol and CPM [9] a direct current polarographic method had been developed for the determination of CPM in pharmaceutical preparations [10].CPM was also determined by differential pulse stripping voltammetry using nano ppy (poly pyrol) and nano PEDOT (poly 3,4-ethylene dioxythiophene) modified glassy carbon electrodes [11]. Simple, rapid, and accurate methods are described for the simultaneous determination of CPM and phenylephrine hydrochloride in two-component mixtures, The first method comprised of measurement of difference absorptivities derivatized, The second method zero-crossing derivative spectrophotometry [12]. A rapid and simple method has been developed for the determination of CPM and phenylpropanolamine Hydrochloride(PPM) by the first derivative UV spectrophotometry in dosage forms [13]. Also, the spectrophotometric method has been developed for the estimation of chlorpheniramine maleate and phenylephrine hydrochloride in bulk and a combined capsule dosage form [14]. Another method was used to estimate the

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CPM content in bulk and pharmaceutical matrix tablets by using the various solvent system [15]. The present work involves the use of the derivative of the convenient order of analytical signal. This method is very useful in the quality control of pharmaceutical products due to the potential of the great majority of the drugs to absorb energy in these wavelengths. The absorption of UV visible radiation occurs through the excitation of electrons within the molecular structure to a higher energy state. Although the selectivity depends on the chromophore of the drug, the aim of this study is to develop a simpler, cheaper, faster, and less environmentally toxic method for the estimation of CPM in pure and pharmaceutical form, these analytical techniques have excellent accuracy, precision, and detection limits, the UV spectrophotometric method was fully validated in this study, employing mainly distilled water, as a solvent, and when we comparing with other previous studies in literature survey we noticed that all literature focused on either zero-order spectra or first and second derivative spectra, and since an increase in the order of derivatives increases the sensitivity of determination [16] then we can say that our study is better than the previous method.

2. Experimental :

2.1. Apparatus:

Spectrophotometric analysis was carried out on a Shimadzu UV-Visible spectrophotometer model UV-1650 PC, connected to a computer with Pantium 4 processor, The optimized conditions for the spectrophotometric measurements were derivative modes ^{1}Dr ($d^1A/d\lambda^1$),^{2}Dr ($d^2A/d\lambda^2$), scan speed fast, slit width 2 nm, derivative UV spectra were recorded over the wavelength range of (200-400) nm, using (1×1×3) cm matched quartz cells.

2.2. Chemicals and solutions:

All chemicals used were of analytical grade. a stock solution of (1×10^{-3})M CPM solution was prepared freshly by dissolving 0.00390 gm CPM (SDI-Iraq) in 10 ml of distilled water, then by proper dilution, other less concentrated solutions were prepared and their spectra recorded.

Histamine tablet (SDI, Iraq,4 mg): Ten tablets were completely grounded and 0.004 gm of the powders were accurately weighed and dissolved in 10 ml distilled water, then the mixture was filtrated with an ordinary filter paper and a clear filtrate solution was used for the determination.

3. Results and Discussions:

The zero-order UV absorption spectra of CPM in distilled water were recorded at different concentrations, The spectrum shows an absorption peak at 226 nm and 262 nm with ε_{max} values 6800 ($L.mol^{-1}.cm^{-1}$) and 3200($L.mol^{-1}.cm^{-1}$) respectively.

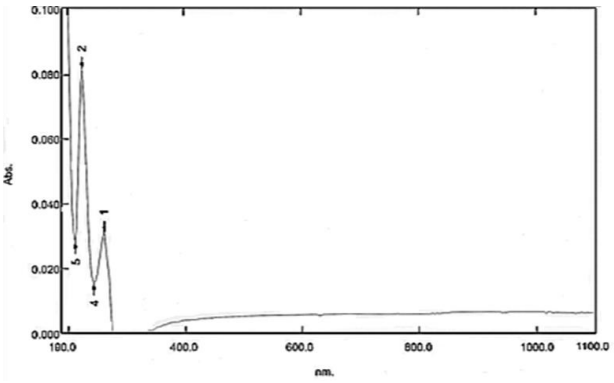

Fig. 2: The UV absorption spectrum of the zero-order derivative of (9×10^{-6}) M of pure CPM.

The quantification of CPM by the zero-order UV absorption spectrum was accomplished at λ_{max}=262 nm by recording the absorbances for a series of different concentration solutions (5×10^{-6} - 1×10^{-4}) M. The plot of these absorbances versus the molar concentrations yields a straight line relationship obeying Beers-Lambert law within a concentration range of (5×10^{-6}-1×10^{-4})M and a determination range of (1.954-39.078)µg/ml with R^2=0.9994 and RSD=0.51%.

The third order UV absorption spectra for CPM in distilled water were recorded for a series of different concentrations solutions which shows a negative peak at (λ= 242-262)nm crossing the zero axis at λ=262 nm and a positive peak at (λ=262-280)nm.

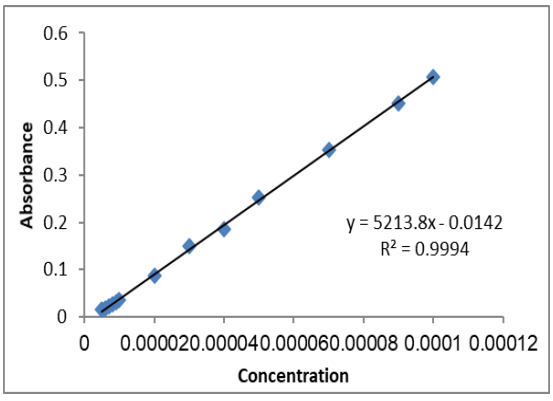

Fig. 3: The calibration curve of the zero-order spectra of CPM

The quantification of CPM in distilled water by third-order derivative UV absorption spectra was accomplished by recording the spectra of a series of different concentration solutions ranging between (5×10^{-6}-1×10^{-4})M and the plot of the integrated area under the negative peak at λ=(242-262) versus the molar concentrations of CPM result in a straight line relationship obeying Beer's-Lambert law within a concentration range(5×10^{-6} - 1×10^{-4})M and a determination range of (1.954 - 39.078) µg/ml with R^2=0.9990 and RSD=0.16%.

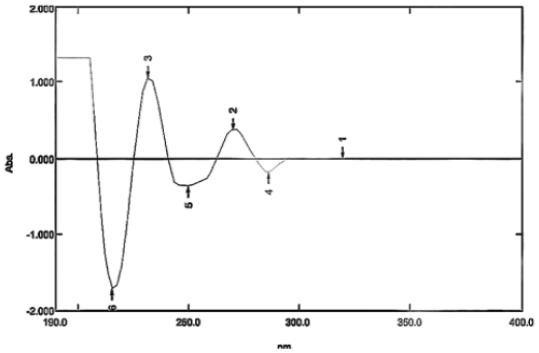

Fig. 4: The UV absorption spectrum of the third-order derivative of (9×10^{-6}) M of pure CPM solution.

Table 1:The absorbance of the zero-order spectra at λ=262 nm for different concentrations of pure CPM.

Molar concentration×10^{-6}	Absorbance
5	0.016
6	0.017
7	0.022
8	0.028
9	0.031
10	0.035
20	0.087
30	0.15
40	0.185
50	0.252
70	0.353
90	0.452
100	0.508

Table 2: The absorbance of the third-order spectra at λ=270 nm for different concentrations of pure CPM.

Molar concentration ×10^{-6}	Absorbance
5	0.225
6	0.251
7	0.297
8	0.35
9	0.376
10	0.408
20	0.837
30	1.398
40	1.674
50	2.235
70	2.959
90	3.839
100	4.279

The quantification by the plot of the integrated area under the positive peak at λ=(262-280)nm versus the molar concentration results in a straight line relationship obeying Beer's-Lambert law within a concentration range between (5×10^{-6}-1×10^{-4})M and a determination range of (1.954 - 39.078) µg/ml with R^2=0.9990 and RSD=1.37%.

The fourth-order derivative absorption spectra of CPM in distilled water were recorded which shows a main positive peak at λ= 264 nm with two satellites at each side of the main positive peak.

The quantification of CPM according to the fourth-order derivative spectra was accomplished by plotting the absorbances of the main positive peak versus the molar concentration of CPM solutions which results in a straight line relationship obeying Beer's- Lambert law within a concentration range(5×10^{-6} - 1×10^{-4})M and a determination limit of (1.954 - 39.078) µg/ml with R^2= 0.9987 and RSD =1.94%

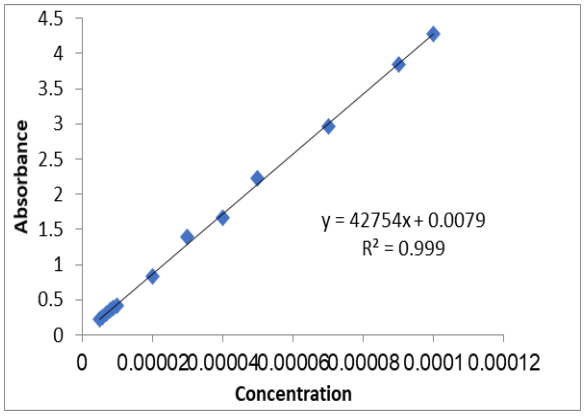

Fig. 5: The calibration curve of the third-order spectra of CPM

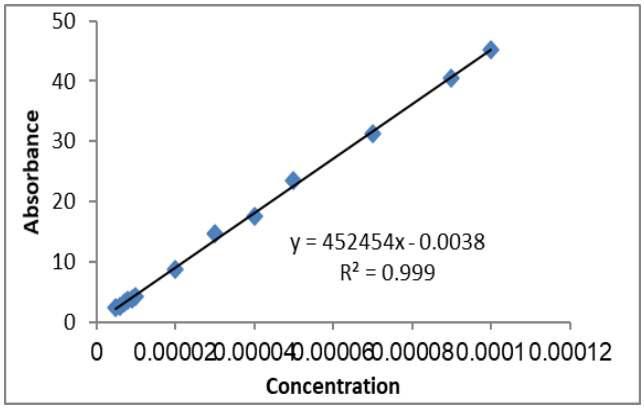

Fig. 6:The calibration curve of the third-order derivative spectra of CPM

Table 3:The integrated areas under the negative peak (262-280)nm of the third-order derivative spectra of CPM solution at different concentrations.

Molar Concentratio×10^{-6}	Integrated Area
5	2.33
6	2.592
7	3.097
8	3.632
9	3.864
10	4.239
20	8.767
30	14.665
40	17.545
50	23.538
70	31.231
90	40.593
100	45.200

Table 4: The absorbance of the fourth-order spectra at λ=264 nm for different concentrations of pure CPM.

Molar concentration ×10^{-6}	Absorbance
5	0.051
6	0.056
7	0.066
8	0.078
9	0.084
10	0.09
20	0.184
30	0.304
40	0.365
50	0.482
70	0.629
90	0.82
100	0.913

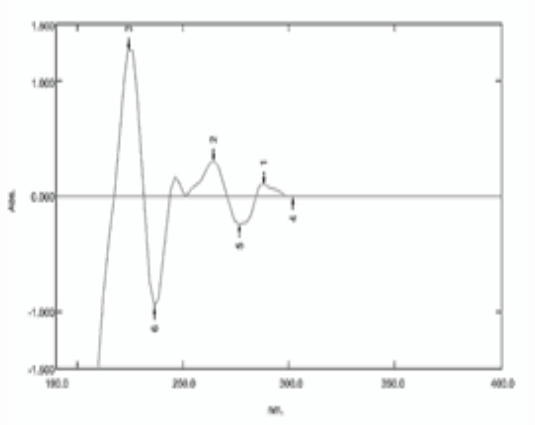

Fig.7: The absorption spectrum of a fourth-order derivative of (3×10^{-5}) M of pure CPM solution.

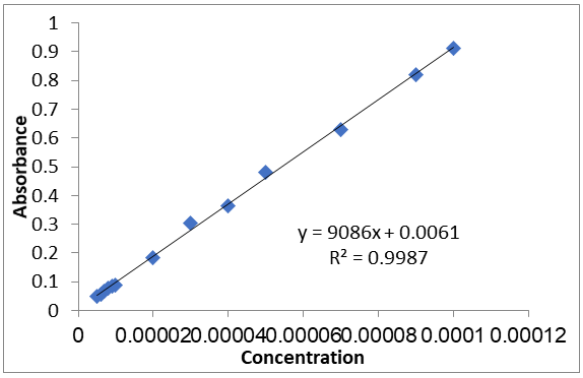

Fig. 8: The calibration curve of the fourth-order derivative spectra of CPM

3.1. Application of method:

The method was applied for determining CPM in histamine tablets by recording the zero-order spectrum of histamine tablets at λ= 242nm. A standard addition method was used to calculate the concentration of CPM in tablets and the recovery percents were estimated. The results are shown in table (5).

Table 5: The results of CPM in histamine tablets by recording the zero-order spectrum at λ= 242nm.

Taken Conc. (M) $\times 10^{-6}$	Found Conc. (M) $\times 10^{-6}$	Absorbance	Recovery%	Error
5	4.83	0.011	96.6	+3.4
10	9.6	0.036	96	+4
100	98.6	0.50	98.6	+1.4

The method was successfully applied for determining CPM in histamine tablets by recording the third-order derivative spectrum of histamine at λ=272 nm at different concentrations and estimate the taken concentration to find the recovery percent as shown in table (6).

Table 6: The results of CPM in histamine tablets by recording the third-order spectrum derivative at λ= 272nm.

Taken Conc. (M) $\times 10^{-6}$	Found Conc. (M) $\times 10^{-6}$	Absorbance	Recovery%	Error
5	5.19	0.23	103.8	-3.8
10	9.63	0.42	96.3	+3.7
100	97.5	4.18	97.5	+2.5

The fourth-order derivative spectrum of histamine tablets was recorded at different concentrations at λ=260 nm and the taken concentration was determined to find the percent recoveries and the results were recorded in the table(7).

Table 7: The results of CPM in histamine tablets by recording the fourth-order spectrum derivative at λ= 260nm.

Taken Conc. (M) $\times 10^{-6}$	Found Conc. (M) $\times 10^{-6}$	Absorbance	Recovery%	Error
5	5.05	0.052	101	-1
10	9.67	0.094	96.7	+3.3
100	101.6	0.93	101.6	-1.6

At the end of the study, and through all results obtained from it, We found that the third-order derivative method was the best approach for the quantitative determination of pure (CPM) and tablet as compared with the zero and fourth-order methods. The determination range of (CPM) was improved by using derivative spectrophotometry which compared with the normal UV spectra.

4. Conclusions:

According to the results above, the derivative UV spectrophotometry appears to be a suitable technique for the reliable analysis of commercial formulations of drugs. it should be noted that the derivative method is simple, sensitive, and rapid. It is also easier and economical than the HPLC separation technique. spectrophotometric methods do not require the use of any expensive or toxic reagent. These advantages make it especially suitable for routine quality control in the tablet.

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