

Determination of Carteolol in Pure and Pharmaceutical Formulation by Spectrophotometric Method

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Abstract

An accurate, simple, fast, and good sensitive Spectrophotometric method have been developed for the determination of Carteolol based on the formation of complex (ion-pair complexes) between the Carteolol (CRT) and Alizarin yellow R Sodium salt (AR) at pH=11.20. This reaction produces a complex red color which is absorbed maximally at 500 nm. Beer's law was obeyed in the range of 1.80-197.30 $\mu\text{g/mL}$ with molar absorptivity of $1.7663 \times 10^3 \text{ L mole}^{-1} \text{ cm}^{-1}$. The effects of analytical parameters on the reported system were investigated. The results were validated statistically. The proposed method was applied to commercially available tablets. Interferences of the other ingredients and excipients were not observed.

Keywords: Carteolol; Complex formation; Spectrophotometry

Introduction

Carteolol is a nonselective beta-adrenergic blocking agent with associated intrinsic sympathomimetic activity and without significant membrane-stabilizing activity. Carteolol hydrochloride reduces normal and elevated intraocular pressure (IOP) whether accompanied by glaucoma or not the correct mechanism of the ocular hypotensive effect of beta-blockers has not been definitely demonstrated. In general, beta-adrenergic blockers reduce cardiac output in patients in good, poor and very cardiovascular health. In different patients with severe impairment of myocardial function and β -blockers may inhibit the sympathetic stimulation necessary to maintain adequate cardiac function. β -adrenergic blockers may also increase airway resistance in the bronchi and bronchioles due to unopposed parasympathetic activity [1-3]. Chemically Carteolol Hydrochloride is 5-[(2RS)-3-[(1,1-Dimethylethyl) amino]-2-hydroxypropoxy]-3, 4-dihydroquinolin-2(1H)-one hydrochloride. It has the molecular formula $\text{C}_{16}\text{H}_{25}\text{N}_2\text{O}_3\text{Cl}$ and the molecular weight is 328.8. Carteolol Hydrochloride is a white, crystalline powder. Carteolol hydrochloride is soluble in water, slightly soluble in alcohol, sparingly soluble in methanol and is practically insoluble in methylene chloride [4,5]. for the simultaneous quantification of carteolol and dorzolamide in rabbit aqueous humor (AH) and ciliary body (CB) has been developed and validated using reversed phase-high performance liquid chromatography (RP-HPLC) with isocratic elution coupled with atmospheric pressure chemical ionization mass spectrometry/mass spectrometry (APCI-MS/MS) [6,7].

Experimental

Materials and methods

All the reagents and chemicals used were of Analytical Reagent Grade. Carteolol Hydrochloride was kindly supplied by GSK Pvt. Ltd. Mumbai, India. Spectral and absorbance measurements were made with UV-Vis Spectrophotometer (OpTMA SP3000 from Korea) double beam spectrophotometer with 1 cm matched quartz cell.

Reagents and solutions

Stijock standard solution of Carteolol ($1 \times 10^{-3} \text{ M}$) was prepared by dissolving 32.88 mg of Carteolol in 100 mL of NaOH (0.03N) in 100 ml volumetric flask. The standard solution was prepared by dilution of the stock standard solution with NaOH (0.03N) to reach concentration ($1 \times 10^{-4} \text{ M}$) of CRT. This solution was stored in a well closed vessel. The solution is stable. Solutions of reagent Alizarin yellow R Sodium salt

(AR) were prepared with a concentration of ($1 \times 10^{-3} \text{ M}$) by dissolving suitable weight of the reagent in NaOH (0.03N) and diluted to the mark in 100 ml volumetric flask.

Buffer solution (PH=2.0 -12.0): different buffer solution was used 0.1M Citrate buffer, 0.1M Ammonium buffer, 0.1M borate buffer and 0.1M Britton buffer solution.

Proposed procedure

To different aliquots of Carteolol (1.80–197.30 $\mu\text{g/mL}$) in tubes, add 61.84 $\mu\text{g/mL}$ of Alizarin yellow R Sodium salt (AR) solution and added 1ml from Britton buffer at pH 11.2. Transfer to 10 mL volumetric flask. Make the volume up to the mark with NaOH (0.03N). Measure the absorbance of the solution at 500 nm against reagent blank.

Results and Discussion

Preliminary investigations have shown that Carteolol reacts with Alizarin yellow R Sodium salt (AR) in Britton buffer pH= 11.20 to give the color complex, which is absorbed at a maximum of 500nm as shown in Figure 1.

To optimize the reaction conditions, different parameters have been investigated such as reagent concentration, color stability, pH buffer and amount of buffer (pH= 11.20).

Effect of time on the stability of the color CRT-AR complex

Developed color was stable up to 2 hours which was considered sufficient time for an analyst to carry out analysis (Figure 2).

Effect of pH buffer

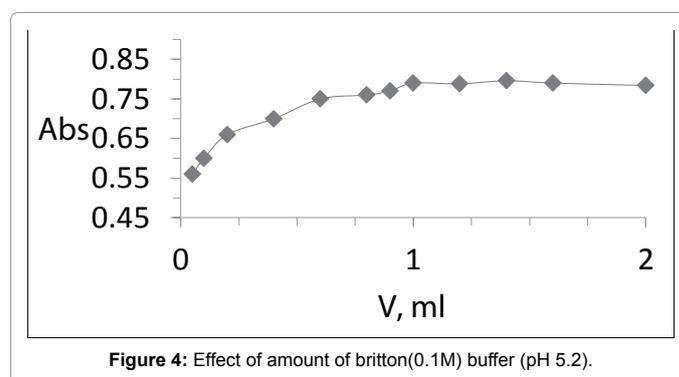
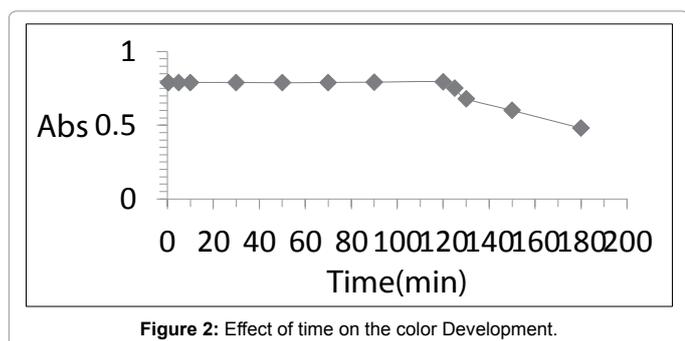
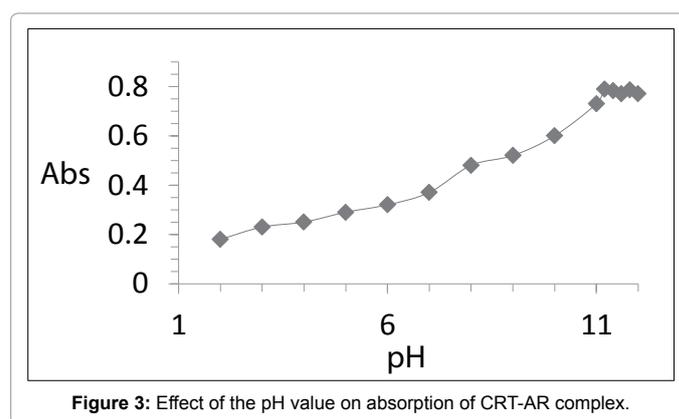
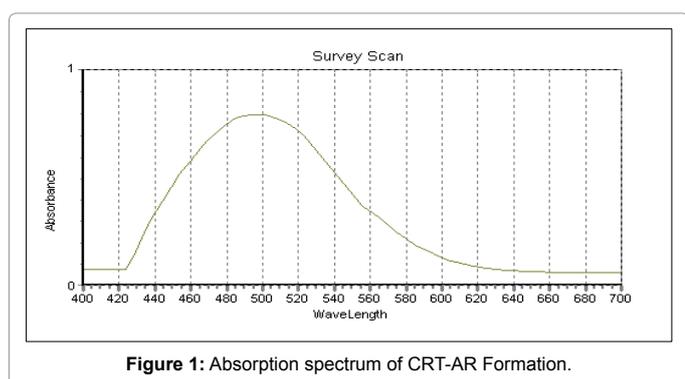
The effect of pH was studied in the presence of various buffers such as Britton, Citrate, borate and Ammonium. It was observed that

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the maximum color intensity and constant absorbance were found in britton buffer solution (0.1M) of pH =11.20 for CRT-AR system using 1 ml of britton buffer solution (0.1M) as shown in Figure 3.

Effect of amount of britton (0.1M) buffer (pH= 11.20)

The optimum of amount of britton buffer solution (0.1M) for the assay of drugs was studied. 1 ml of britton buffer solution (0.1M) pH= 11.20 sufficient for complete color development for CRT-AR complex as shown in Figure 4.

Effect of reagent concentration

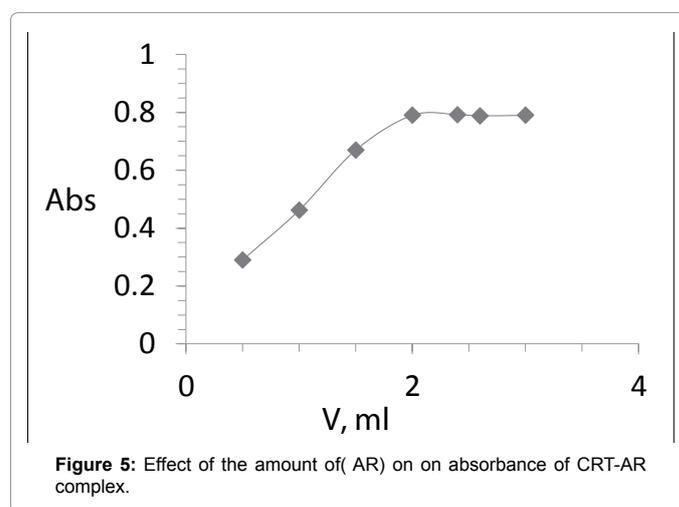
The effect of Alizarin yellow R Sodium salt (AR) concentration on the color development was investigated. 2.0 mL of Alizarin yellow R Sodium salt (10^{-3} M) reagent produced maximum color intensity (Figure 5).

Molar Ratios Determination of CRT-AR complex

The molar ratio was determined using the molar ratio methods [8] and continuous variation [9] methods. The ratio were found to be 1:3 for CRT:AR (Figures 6 and 7).

Linearity and sensitivity

A linear relation was obtained between absorbance and concentration of CRT in the range of 1.80–197.30 $\mu\text{g}/\text{mL}$ (Figure 8). The graphs show negligible intercept and they are described by the regression equation, $A = mC + b$ (where A is the absorbance of 1 cm layer, m is the slope, b is the intercept and C is the concentration of the measured solution in $\mu\text{g}\cdot\text{ml}^{-1}$) obtained by the least-squares method [10]. The high molar absorptivity of the resulting colored complex indicate the good sensitivity of the method. The Beer's law limits, Sandell sensitivity, molar absorptivity, linear regression equation, correlation coefficient and detection limit [11] determined for the method are given in Table 1.



Accuracy and precision

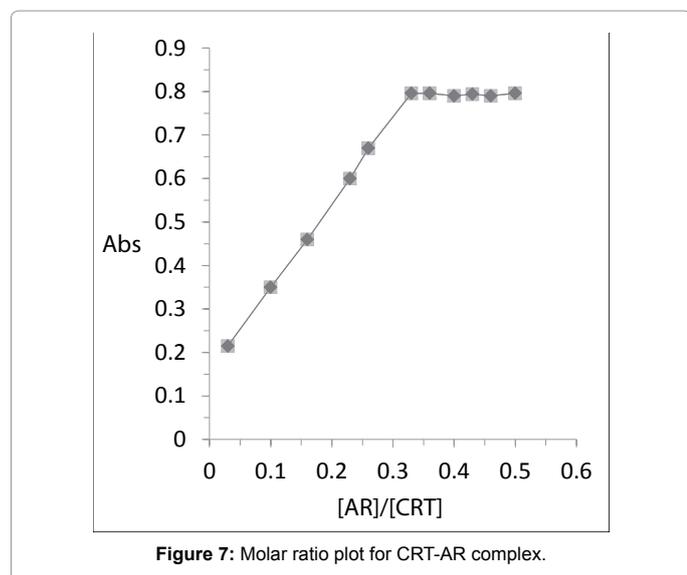
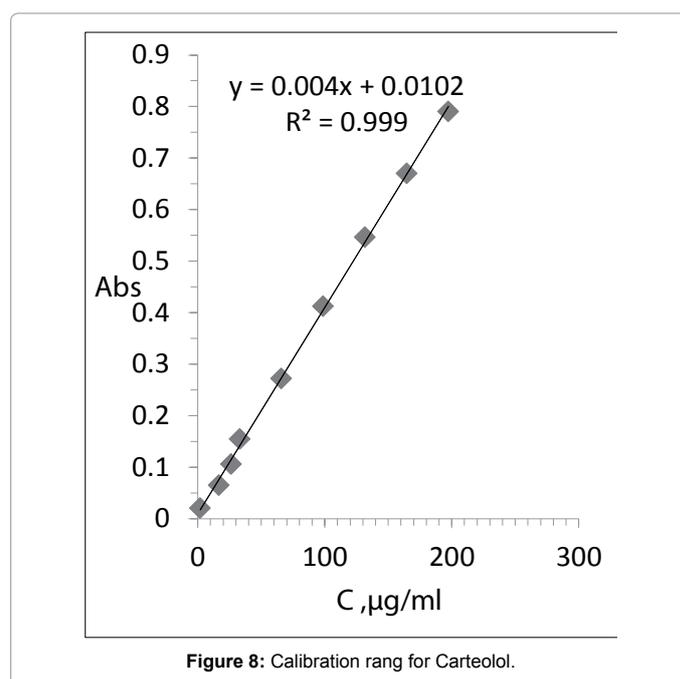
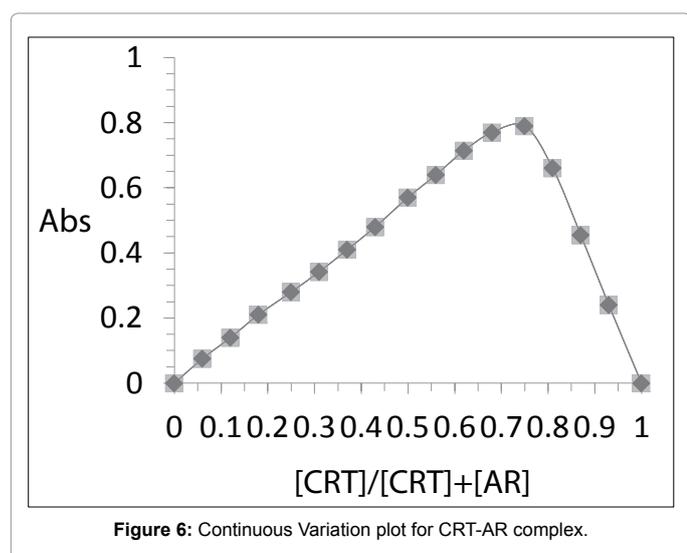
The results obtained are summarized in Table 2. The low values of relative standard deviation (RSD) indicates good precision and reproducibility of the method. The average percent recoveries obtained were 95.55 – 100.83%, indicating good accuracy of the methods [12,13].

Application to the pharmaceutical dosage forms

The proposed method has been successfully applied to the determination of CRT in pharmaceutical preparations Table 3. The ingredients in the tablets did not interfere in the experiments.

Conclusion

The proposed method for the estimation of Carteolol using Alizarin



Parameter	Value
λ_{max} (m)	500
Beer's law limit ($\mu\text{g/mL}$)	1.80–197.30
Molar absorptivity ($\text{L mole}^{-1} \text{cm}^{-1}$)	1.7663×10^3
Sandell's sensitivity ($\mu\text{g/mL per } 0.001 \text{ A}$)	0.18
Slope (m)	0.0044
Intercept (c)	0.0102
Correlation coefficient	0.999
Relative Standard Deviation*	3.48
Limit of Detection ($\mu\text{g/mL}$)	0.52
Limit of quantitation ($\mu\text{g/mL}$)	1.75

$Y = mx + C$
 Where X is the concentration of analyte ($\mu\text{g/mL}$) and Y is absorbance unit.
 * = Calculated from five determinations

Table 1: Optical characteristics and statistical data for the regression equation of the proposed method.

CRT Taken ($\mu\text{g/ml}$)	CRT Found* ($\mu\text{g/ml}$)	Standard Deviation SD	Relative Standard Deviation RSD %	analytical Error SD/ (n) ^{1/2}	Confidence limit ($\mu\text{g/ml}$)	Recovery% R (%)
1.80	1.72	0.060	3.48	0.026	1.80 ± 0.072	95.55
16.44	16.08	0.271	1.68	0.121	16.08 ± 0.335	97.81
26.30	25.8	0.667	2.58	0.298	25.8 ± 0.827	98.09
32.88	32.75	0.089	0.27	0.039	32.75 ± 0.108	99.6
65.76	66.31	0.676	1.01	0.302	66.31 ± 0.838	100.83
98.65	99.43	1.536	1.54	0.686	99.43 ± 1.904	100.79
131.53	131.96	0.588	0.44	0.262	131.96 ± 0.727	100.32
164.42	165.26	1.183	0.71	0.529	165.26 ± 1.468	100.51
197.30	196.36	1.254	0.63	0.560	196.36 ± 1.554	99.52

*Average of five determinations.

Table 2: Study of the precision and of the accuracy of the method.

Formulation	Label claim (mg)	CRT Taken ($\mu\text{g/ml}$)	CRT Found ($\mu\text{g/ml}$)	Standard Deviation SD	Content determined* (mg)	Relative Standard Deviation RSD %	Recovery% R (%)
CALTE	100	50	49.68	0.474	99.36	0.95	99.36
	10	100	99.32	0.506	99.32	0.51	99.32

*Five independent analyses

Table 3: Results of the estimation of CRT in tablets.

yellow R Sodium salt (AR) are advantageous over many of the reported methods. The methods are rapid, simple and have good sensitivity and accuracy. Proposed method makes use of simple reagent, which an ordinary analytical laboratory can afford. The high recovery percentage and low relative standard deviation reflect the high accuracy and precision of the proposed method. The method are easy, applicable to a wide range of concentration, besides being less time consuming and depend on simple reagent which are available, thus offering economic and acceptable method for the routine determination of Cartelol in its formulations.

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