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 μg/mL with molar absorptivity of 1.7663×10^4 L mole⁻¹cm⁻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 non-selective 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 effects. β- blockers may also increase airway resistance in the bronchi and bronchioles due to unopposed parasympathetic effects. β- blockers may also increase airway resistance in the bronchi and bronchioles due to unopposed parasympathetic effects. β- blockers may also increase airway resistance in the bronchi and bronchioles due to unopposed parasympathetic effects.

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
Stiitck standard solution of Carteolol (1×10⁻⁴ 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 (1×10⁻⁴ 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 (1×10⁻³ 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.

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 pH on the stability of the color CRT-AR complex
To different aliquots of Carteolol (1.80–197.30 μg/mL) in tubes, add 61.84 μg/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.

Effect of pH buffer
The effect of pH was studied in the presence of various buffers (1×10⁻³ M) of CRT. This solution was stored in a well closed vessel. The solution is stable. Solutions of reagent Alizarin yellow R Sodium salt

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

**Effect of amount of brillon (0.1M) buffer (pH= 11.20)**

The optimum of amount of brillon buffer solution (0.1M) for the assay of drugs was studied. 1 ml of brillon 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 μg/mL (Figure 8). The graphs show negligible intercept and they are described by the regression equation, A = m C + 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 μg/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 Cartelol using Alizarin

**Figure 6:** Continuous Variation plot for CRT-AR complex.

**Figure 7:** Molar ratio plot for CRT-AR complex.

**Figure 8:** Calibration rang for Carteolol.

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\lambda_{max}$ (m)</td>
<td>500</td>
</tr>
<tr>
<td>Beer’s law limit (μg/mL)</td>
<td>1.80–197.30</td>
</tr>
<tr>
<td>Molar absorptivity (L mole$^{-1}$ cm$^{-1}$)</td>
<td>1.7663×10$^3$</td>
</tr>
<tr>
<td>Sandell’s sensitivity (μg/mL per 0.001 A)</td>
<td>0.18</td>
</tr>
<tr>
<td>Slope (m)</td>
<td>0.0044</td>
</tr>
<tr>
<td>Intercept (c)</td>
<td>0.0102</td>
</tr>
<tr>
<td>Correlation coefficient</td>
<td>0.999</td>
</tr>
<tr>
<td>Relative Standard Deviation*</td>
<td>3.48</td>
</tr>
<tr>
<td>Limit of Detection (μg/mL)</td>
<td>0.52</td>
</tr>
<tr>
<td>Limit of quantitation (μg/ml)</td>
<td>1.75</td>
</tr>
</tbody>
</table>

$Y = mx + c$
Where X is the concentration of analyte (μg/mL) and Y is absorbance unit.

* = Calculated from five determinations

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

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Label claim (mg)</th>
<th>CRT Taken (μg/ml)</th>
<th>CRT Found (μg/ml)</th>
<th>Standard Deviation SD</th>
<th>Content determined* (mg)</th>
<th>Relative Standard Deviation RSD %</th>
<th>Recovery% R (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALTE</td>
<td>100</td>
<td>50</td>
<td>49.68</td>
<td>0.474</td>
<td>99.36</td>
<td>0.95</td>
<td>99.36</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>100</td>
<td>99.32</td>
<td>0.506</td>
<td>99.32</td>
<td>0.51</td>
<td>99.32</td>
</tr>
</tbody>
</table>

*Average of five determinations.

*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 Carteolol in its formulations.

References