UV SPECTROSCOPY ESTIMATION OF AMBROXOL HCL AND COMPARISON OF THEIR DISSOLUTION PROFILES

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ABSTRACT

Ambroxol Hydrochloride is a commonly used medication that is available in multiple varieties, making it difficult to choose the safest and most effective one. Therefore, the purpose of this study is to establish the pharmaceutical equivalence of the various brands of Ambroxol Hydrochloride tablets and to validate the quality of the various brands on the market. The study involves the quantitative analysis of ten different brands of Ambroxol Hydrochloride 30 mg tablets using Ultra Violet Spectrophotometric methods, in which the samples were dissolved in distilled water and their absorbances were measured at a wavelength (max) of 243 nm. Quantitative determination of Ambroxol Hydrochloride by UV-Visible Spectrophotometric methods, utilizing standard absorptivity value (assay method described in the Indian Pharmacopoeia) and calibration curve method. The percentage content of each sample was determined using both methods and the appropriate formulas, as well as whether or not the samples complied with IP standard specifications. Using the IP Method, the percentage of Ambroxol Hydrochloride in various brands of Ambroxol Hydrochloride tablets was compared. In addition, the IP method and Calibration curve method outcomes were compared.

Keywords: UV- Visible Spectrophotometry, Ambroxol Hydrochloride tablet, Standard absorptivity method, Calibration curve method, Indian Pharmacopoeia.

INTRODUCTION

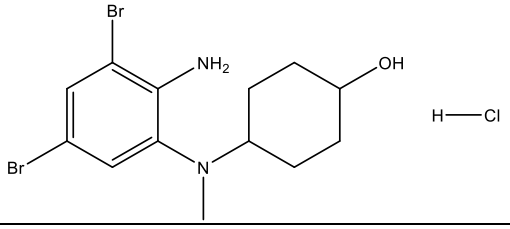
Ambroxol is a metabolite of bromhexine that has effects and applications that are similar to those of bromhexine. The name given to this compound by chemists is trans-4-[(2-Amino-3,5-dibromobenzyl) amino]-cyclohexanol. It is a mucolytic agent and an expectorant, and its purpose is to decrease the formation of mucus that is excessive or thick. Its hydrochloride has been used successfully for decades as a secretion-releasing expectorant in the treatment of a

wide variety of respiratory conditions. Because of its short biological half-life of 4 hours, which requires frequent daily dosing of between 2 and 3 times, and its therapeutic usage in chronic respiratory disorders [1, 2], its formulation as a sustained-release dosage form is required. This is due to the fact that its biological half-life is so short.

Therefore, the development of sustained/controlled release formulations of ambroxol hydrochloride is therapeutically important and can be utilised to deliver a constant dosage by maintaining an adequate drug level throughout time [3]. This is made possible by the sustained/controlled release technology. The way that is both the simplest and the most cost-effective for controlling the release of the drug is to disperse it within an inert polymeric matrix. In addition, hydrophilic matrices present an attractive possibility for the formulation of oral sustained release (SR) drugs. The solubility of the medication in the polymer matrix or, in the case of porous matrices, the solubility of the sink solution inside the pore network of the particle can have an effect on the dose release features of matrix devices [4]. Porous matrices are more likely to have this effect. Hydroxypropylmethylcellulose, also known as HPMC, is the most commonly used hydrophilic vehicle when it comes to the formulation of controlled drug delivery systems for oral administration. There have been a lot of studies published in the scientific literature looking into how HPMC matrices can control the discharge of different pharmaceuticals from matrices [5, 6].

This study aimed to determine the amount of ambroxol hydrochloride present in a variety of different formulations.

Table 1: Ambroxol Hydrochloride drug Profile [7-9]

Common Name	Ambroxol Hydrochloride
Chemical Name	Ambroxol Hydrochloride
Structure	
Molecular Formula	$C_{13}H_{18}Br_2N_2O$
Molecular Weight	414.56 g/mol
Description	White crystalline solid
Melting point	234-236°C
Boiling point	467-469°C
pH	4.5 – 5.5
Solubility	Soluble in water and methanol.
Category	Mucolytic agents
Dose	30 mg
Storage	Store protected from light and moisture.

The study of the absorption of UV and visible radiations, which have a wavelength between 200 and 800 nm, is the focus of UV-visible spectroscopy. The promotion of a valence electron from a bonding orbital to an anti-bonding orbital by UV radiation occurs 15. Beer-Lambert's Law can be used to calculate the analyte concentration in the solution by measuring the absorbance at a specific wavelength. Chemical substances can be analysed quantitatively and qualitatively using UV-Visible spectroscopy [10].

A medicine, a biological material, or an organic sample could all fall within the category of a target entity. An assay is a method of investigation that can qualitatively evaluate or

quantitatively quantify the presence, amount, or functional activity of a target entity. This can be done in either direction. Manufacturers of pharmaceuticals are required to comply with severe regulatory regulations and provide evidence that their products meet criteria including "high quality, safe, effective, and free of contamination and defects." Assays are an essential component of this procedure [11, 12] because they enable a comparison to be made between the concentration of a medicine and the amount that is given on the label.

The term "spectrophotometer" refers to an instrument that provides a quantitative analysis of the reflection or transmission characteristics of a material in relation to the wavelength. It is possible to do the assay of an absorbent substance in a short amount of time by making a solution in a solvent that is transparent, then measuring the absorbance of that solution at a wavelength that is appropriate [13].

Using Standard Absorptivity value

For stable compounds with moderately broad absorption bands and which are essentially unaffected by changes in experimental parameters, such as slit width and scan speed, official compendia, such as the Indian Pharmacopoeia, use this approach. It is unnecessary to produce a standard solution of the reference substance to calculate its absorptivity when standard A (1%, 1cm) or values are used. The concentration of the sample is ascertained by comparing it to the standard value, which is established as the absorptivity value A (1%, 1 cm) of a standard at a chosen wavelength in a particular solvent [14].

Standard Calibration Graph

During this step of the process, a calibration graph is generated by measuring the absorbances of a number of standard solutions (typically between 4 and 6) of the reference substance at concentrations that range from the sample concentrations. Reading the concentration on the graph as the concentration that corresponds to the absorbance of the sample solution allows one to calculate the concentration of the analyte in the sample solution. The method of least squares can be used to determine the regression line $y = mx + c$ if there is a linear relationship between the absorbance values and concentrations. This line will have the equation $y = mx + c$ [15].

Where y = Absorbance of sample solution

m = Slope of a line

x = Concentration of sample solution

c = Intercept.

MATERIALS AND METHODS

Materials

Ambroxol Hydrochloride API- Mfg. by LOBA CHEMIE Laboratory Reagents and Fine Chemicals Pvt. Ltd. Ambroxol Hydrochloride Tablets 30 mg- Ten different brands of Ambroxol Hydrochloride 500mg Tablets were purchased from the market and used as a sample [16].

Instruments

UV-Visible double beam Spectrophotometer with matched quartz cells (1 cm) **(**Model- Shimadzu UV-1800)**,** Analytical balance **(**Model- ACZET CY 124C) [17].

Selection of Methods:

The methods employed for this study are the UV-Visible Spectrophotometric methods.

1. Using standard absorptivity value (IP method)
2. Calibration curve method.

Determination of λmax of Ambroxol Hydrochloride

10 µg/ml of Ambroxol Hydrochloride solution was scanned between 400nm to 200nm. The absorption maxima (λmax) were found to be at 243 nm [18]. 243nm λmax was used for the Calibration curve method (as shown in **figure 1**).

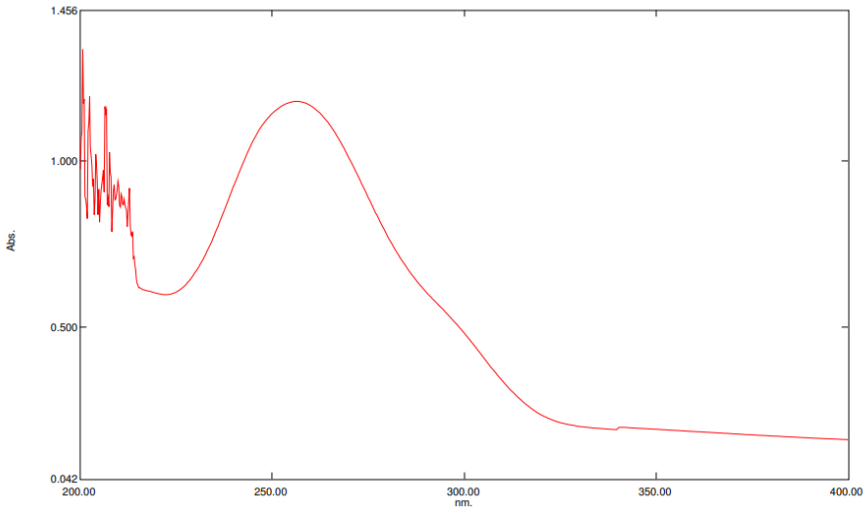


Figure 1: Absorption Maxima (λmax) of Ambroxol Hydrochloride at 243 nm.

Absorption maxima of Ambroxol Hydrochloride in Distilled water solution was found to be at 243 nm.

Assay procedure

All brands of Ambroxol Hydrochloride tablets were assayed spectrophotometrically by using the following methods [19]

1. Using standard absorptivity value (IP Method)

20 Ambroxol Hydrochloride tablets, 20 from each brand, were weighed and finely mashed in a mill and pestle. A piece of powder precisely weighed to equal 30 mg of ambroxol hydrochloride was added to a 100 ml volumetric flask along with 50 ml of distilled water and mechanically agitated for 15 minutes. Then, enough distilled water was added to the mixture to make 100 ml. The resulting product was then filtered using Whatman filter paper No. 41. Ten millilitres of the filtrate were added to a 100 millilitre volumetric flask, which was then further diluted to 100 millilitres with distilled water. Once more, 10 ml of the resulting solution was thoroughly mixed with 10 ml of distilled water before being diluted to 100 ml with more distilled water. The UV Spectrophotometer was reset to zero by completing a baseline (between 400 and 200 nm) using distilled water as a blank. At 243 nm, the absorbance of each sample was calculated. Ambroxol hydrochloride's concentration was calculated based on its highest specific absorbance at 243 nm [20, 21].

2. Calibration Curve Method

Preparation of standard stock solution

By dissolving 30 mg of pure Ambroxol Hydrochloride powdered medication in 50 ml of distilled water and diluting to 100 ml with distilled water, a standard stock solution of Ambroxol Hydrochloride (100 g/ml) was created. A 100 ml volumetric flask was filled with

10 ml of the aforementioned solution, which was then further diluted to 100 ml with distilled water [22].

Preparation of standard dilutions

Six standard dilutions were created from the aforementioned 100 g/ml stock solution by adding distilled water to the following volumes: 0.2 ml, 0.4 ml, 0.6 ml, 0.8 ml, 1.0 ml, and 1.2 ml. The absorbance of six standard dilutions at concentrations of 2 g/ml, 4 g/ml, 6 g/ml, 8 g/ml, 10 g/ml, and 12 g/ml was measured in comparison to a distilled water blank solution. The calibration curve between concentration and absorbance was displayed at 243 nm [23, 24].

Preparation of Sample solution

Twenty tablets were weighed and finely pulverised in a mortar and pestle. 30 mg of ambroxol hydrochloride was correctly weighed out into a 100 ml volumetric flask's contents. 50 ml of distilled water were added to this, along with 50 ml of further distilled water, and the mixture was mechanically agitated for 15 minutes. The mixture was then diluted with 100 millilitres of distilled water. Following that, Whatman filter paper No. 41 was used to filter the end product. Ten millilitres of the filtrate were added to a 100 millilitre volumetric flask, which was then further diluted to 100 millilitres with distilled water. The resulting solution was diluted to 100 ml with pure water, then 10 ml was carefully added. The UV Spectrophotometer was reset to zero by completing a baseline (between 400 and 200 nm) with distilled water solution as a blank. At 243 nm, the absorbance of each sample was determined [25]. The % content of ambroxol hydrochloride was calculated using a linear regression equation obtained from the standard calibration plot (as shown in figure 2).

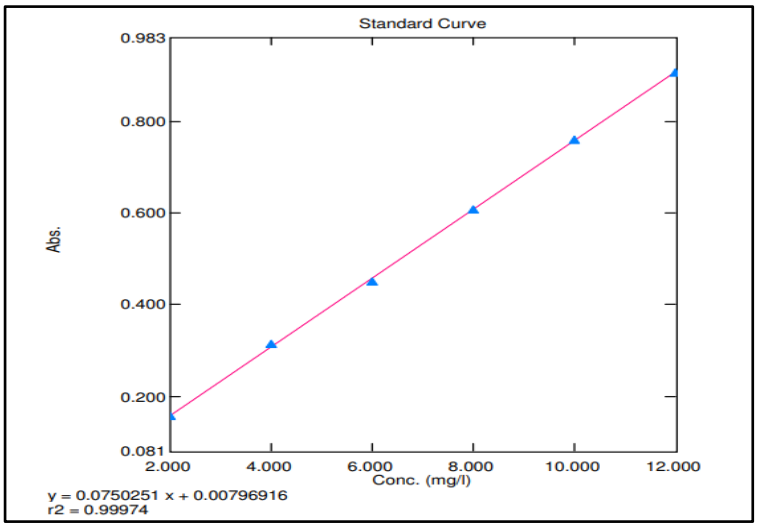


Figure 2: Standard Calibration Curve of Ambroxol Hydrochloride

The standard calibration curve of series of standard dilutions of Ambroxol Hydrochloride is plotted against absorbance and concentration in ppm.

RESULT AND DISCUSSION

This investigation involved the assay of ten brands of tablets containing ambroxol hydrochloride made by various manufacturers. Using UV-Visible Spectroscopic techniques, the average weight and % content of ambroxol hydrochloride in several brands of ambroxol hydrochloride tablets were estimated and assessed.

The results from the IP technique are listed in Table 2 below.

Table 2: Comparison of different brands of Ambroxol Hydrochloride Tablets 30mg by IP method

Sr. No.	Brand Name	Label Claim (in mg)	Average Weight (in mg)	Percentage Content (in %)	IP Specifications (in %)	Inference
1.	F1	30	101	100	96.0-100.0	PASS
2.	F2	30	100	101		PASS
3.	F3	30	99	99		PASS
4.	F4	30	101	101		PASS
5.	F5	30	101	101		PASS
6.	F6	30	100	100		PASS
7.	F7	30	99	99		PASS
8.	F8	30	101	101		PASS
9.	F9	30	100	100		PASS
10.	F10	30	100	100		PASS

Using the Standard Absorptivity Value (IP Method), the percentage of ambroxol hydrochloride present in various brands of ambroxol hydrochloride tablets is compared.

According to the results of the IP method, all ten brands of Ambroxol Hydrochloride tablets passed the assay because their percentage content was within the limit set by the Indian Pharmacopoeia. Two brands, however, failed because one of them contained below the limit and the other contained above it.

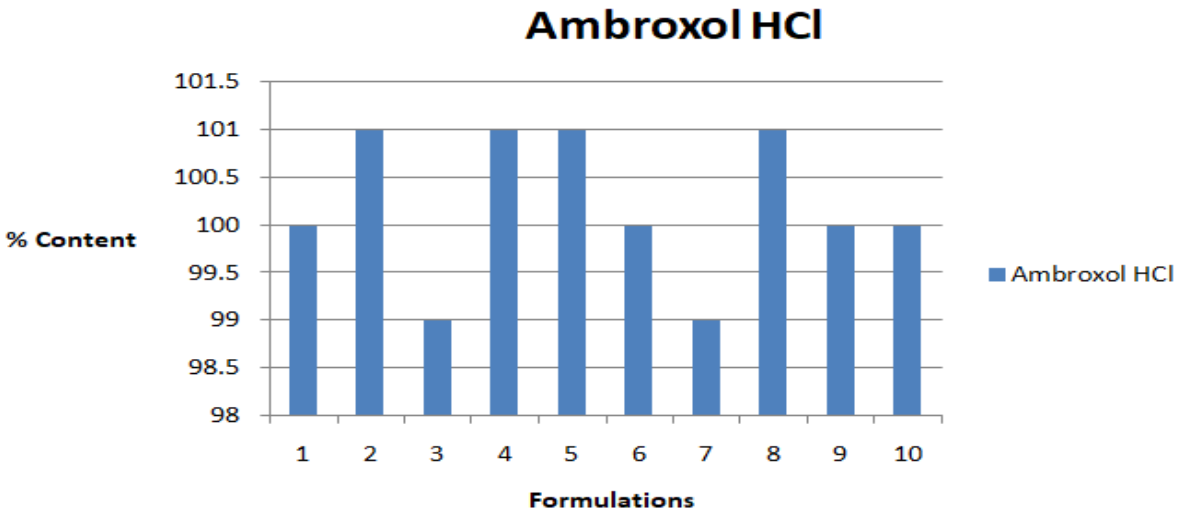


Figure 3: Comparison of various brands of Ambroxol Hydrochloride tablets by IP method.

The chart provides a graphical comparison of the findings from the calibration curve method and the standard absorptivity value method (IP Method).

The standard absorptivity value (assay technique provided in IP) and calibration curve method were both successful in estimating the % content of ambroxol hydrochloride in various brands of ambroxol hydrochloride tablets. The next table (Table 3) compares and summarises the outcomes of the two approaches.

Table 3: Comparison of Assay Methods

Sr. No.	Brand Name	% Content by IP Method	% Content by Calibration Curve Method
1.	F1	100	99
2.	F2	101	100
3.	F3	99	99
4.	F4	101	101
5.	F5	101	100
6.	F6	100	100
7.	F7	99	100
8.	F8	101	101
9.	F9	100	99
10.	F10	100	99

Comparison is made between the results obtained using the Standard Absorptivity Value (IP Method) and the Calibration Curve Method.

The percentage composition of ambroxol hydrochloride in ambroxol hydrochloride tablets made using the two processes differs, per the data from both methods. Comparing the IP technique and the Calibration curve method, the IP approach shows a slightly greater percentage content of ambroxol hydrochloride.

The following pattern was noticed in the difference between the two procedures used to test the tablets of ambroxol hydrochloride:

1. The IP approach outperforms the calibration curve method in terms of results.

2. By 4-6% more Ambroxol Hydrochloride is present in the IP method than in the calibration curve method.

Figure 4 compares the outcomes of the calibration curve method and the standard absorptivity value method (IP Method).

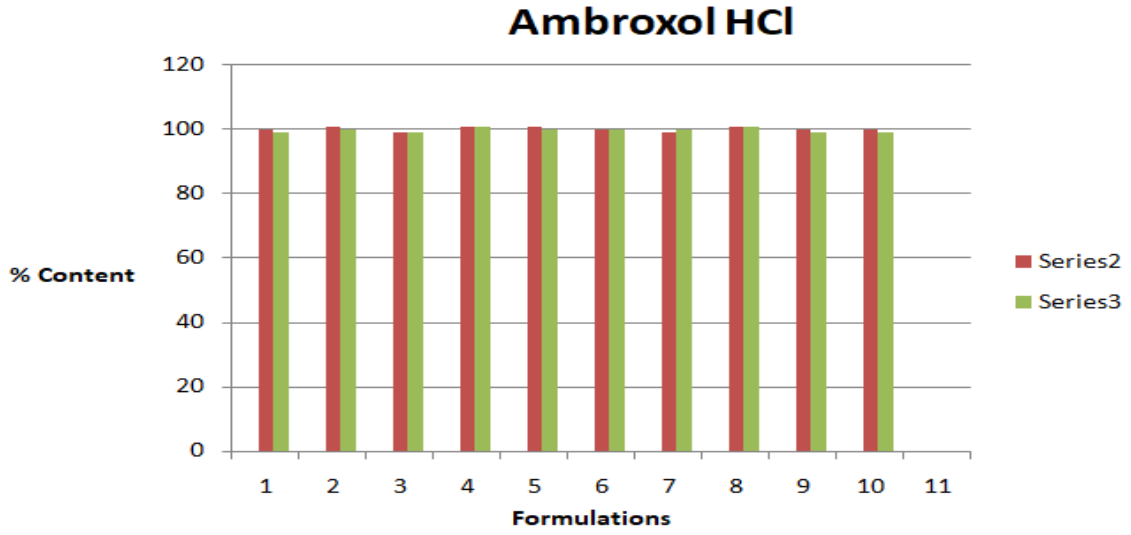


Figure 4: Comparison of assay methods.

The graph compares the percentage content of ambroxol hydrochloride across different brands of ambroxol hydrochloride tablets using the IP Method.

CONCLUSION

According to the mentioned study, the branded formulations sold by reputable pharmaceutical companies demonstrate that the percentage of ambroxol hydrochloride present in ambroxol hydrochloride tablets corresponds with the guidelines provided in the Indian Pharmacopoeia. Some generic tablets also meet the assay limit specified in IP, but some generic tablets did not meet the IP-specified assay limit. The results of this study thus imply that regulations governing the approval of pharmaceutical goods need to be improved.

This study also demonstrates that the outcomes from the Calibration Curve Method and the Standard Absorptivity Value Method differ noticeably from one another. In comparison to the Calibration curve approach, the IP method reveals a little greater percentage content of ambroxol hydrochloride in all brands of ambroxol hydrochloride tablets.

DECLARATIONS

Ethics approval and consent to participate

Not applicable.

Consent for publication

All the authors approved the manuscript for publication.

Availability of data and material

All required data is available.

Competing interests

All authors declare no competing interests.

Funding

Not applicable.

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