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Research Paper

Implementation Of Hydrotropic Solvents for Uv Spectrophotometric Assessment of Telmisartan and Indomethacin: A Green Analytical Approach

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ABSTRACT

The present study focuses on the implementation of hydrotropic solubilization as an eco-friendly alternative to conventional organic solvents in UV spectrophotometric analysis of poorly water-soluble drugs. Telmisartan and Indomethacin were selected as model drugs due to their limited aqueous solubility. A 2 M urea solution was employed as a hydrotropic agent to enhance drug solubility without the use of toxic organic solvents such as methanol. The maximum absorption wavelengths (λmax) were determined to be 240 nm for Telmisartan and 320 nm for Indomethacin. Calibration curves were constructed within the concentration range of 10–100 µg/mL and exhibited excellent linearity with correlation coefficients (R^2) of 0.9978 and 0.9968, respectively. The proposed method demonstrated simplicity, accuracy, precision, cost-effectiveness, and environmental sustainability. Greenness evaluation indicated a significant reduction in hazardous solvent consumption, supporting the principles of Green Analytical Chemistry. The developed method is suitable for routine pharmaceutical quality control and can be extended to other poorly soluble drugs

INTRODUCTION

UV-visible spectrophotometry is a widely used analytical technique in pharmaceutical analysis due to its simplicity, accuracy, rapidity, and cost-effectiveness.[1] However, the estimation of poorly water-soluble drugs often requires organic solvents such as methanol and ethanol, which are associated with toxicity, environmental hazards, and disposal challenges.[2]Hydrotropy is an effective solubilization technique that enhances the aqueous solubility of poorly soluble drugs through the use of hydrotropic agents such as urea, sodium benzoate, and nicotinamide. These agents provide a safer, economical, and environmentally

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friendly alternative to conventional organic solvents.[3]

Telmisartan, an angiotensin II receptor blocker, and Indomethacin, a non-steroidal anti-inflammatory drug, are both poorly water-soluble drugs that present difficulties in routine spectrophotometric analysis.[4] The present study explores the use of 2 M urea as a hydrotropic solvent for the UV spectrophotometric estimation of Telmisartan and Indomethacin.[5] The method aims to reduce the use of hazardous organic solvents while maintaining analytical accuracy, precision, and reliability. Additionally, the greenness of the developed analytical procedure was evaluated in accordance with Green Analytical Chemistry principles, highlighting its suitability for sustainable pharmaceutical analysis.[6]

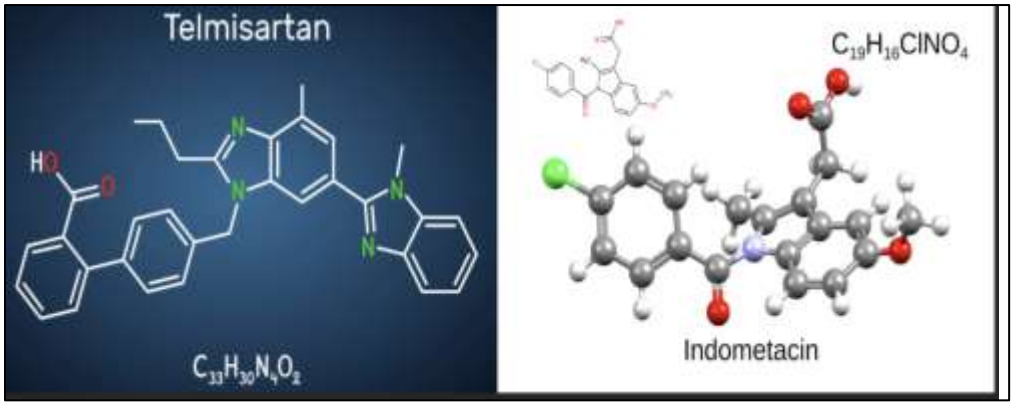

Figure 1. Chemical Structures of Telmisartan and Indomethacin

Materials

Telmisartan and Indomethacin active pharmaceutical ingredients (APIs) were used as model drugs in the present study. Urea of analytical reagent grade was employed as the hydrotropic agent to enhance the aqueous solubility of the drugs. Distilled water was used for the preparation of the hydrotropic solution and all subsequent dilutions. All chemicals and reagents used in the study were of analytical grade and were used without further purification.

instrumentation

Analysis was performed using a Shimadzu UV-1800 Double Beam UV-Visible Spectrophotometer equipped with 1 cm matched quartz cells.[7]

Preparation of Hydrotropic Solvent

A 2 M urea solution was prepared by dissolving 12.01 g of urea in distilled water and making the volume up to 100 mL.[8]

Method:

Preparation of Standard Stock Solution

Accurately weighed 10 mg of drug was transferred into a 100 mL volumetric flask. Approximately 30 mL of 2 M urea solution was added, and the mixture was sonicated until complete dissolution. The volume was then adjusted to 100 mL using the same solvent to obtain a stock solution of 100 µg/mL.[9]

Preparation of Working Solutions

Aliquots of stock solution were diluted with 2 M urea solution to obtain concentrations ranging from 10–100 µg/mL.[10]

Determination of λmax

The prepared solutions were scanned between 200–400 nm against a reagent blank containing 2 M urea solution.[11]

Construction of Calibration Curve

Absorbance was measured at the respective λmax values, and calibration curves were plotted between concentration and absorbance.[12]

Table 1. Maximum Absorption Wavelengths (λmax) of Telmisartan and Indo

Drug	λmax (nm)
Telmisartan	240
Indomethacin	320

RESULTS

UV Spectral Characteristics

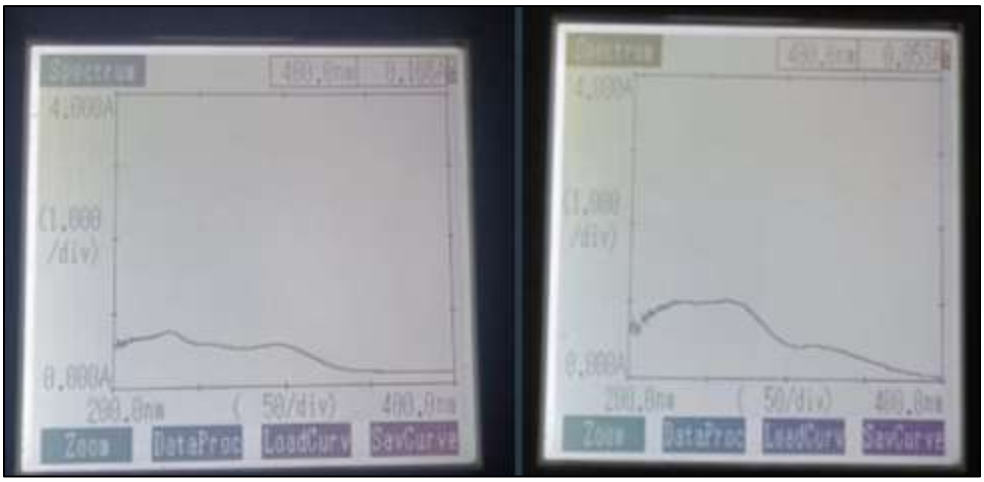

Figure 2. UV Absorption Spectra of Telmisartan and Indomethacin in 2 M Urea Solution Showing λmax at 240 nm and 320 nm, Respectively.

The hydrotropic solvent did not interfere with absorbance measurements and produced well-defined absorption maxima.

Calibration Data of Telmisartan

Table 1. Calibration Data of Telmisartan in 2 M Urea Solution at 240 nm

Concentration (µg/mL)	Absorbance
10	0.103
20	0.197
30	0.303
40	0.410
50	0.523
60	0.632
70	0.709
80	0.805
90	0.886
100	0.987

Regression coefficient (R^2) = 0.9978

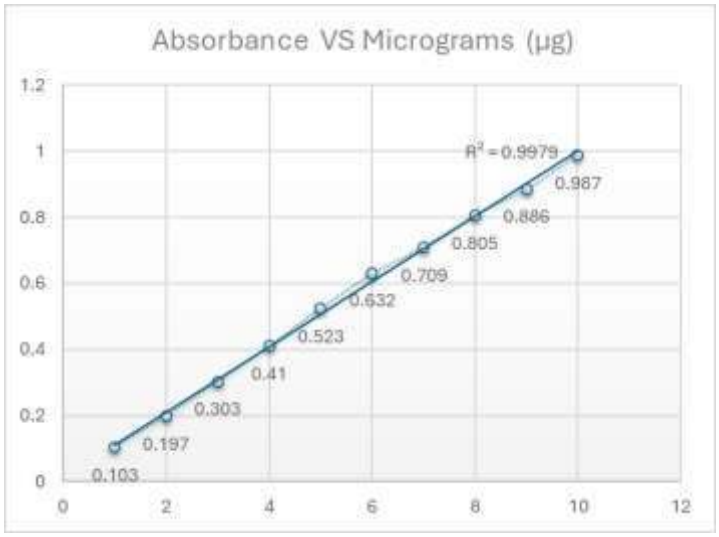

Figure 3. Calibration Curve of Telmisartan in 2 M Urea Solution

Calibration Data of Indomethacin

Table 2.Calibration Data of Indomethacin in 2 M Urea Solution at 320 nm

Concentration (µg/mL)	Absorbance
10	0.110
20	0.251
30	0.405
40	0.552
50	0.692
60	0.820
70	0.990
80	1.200
90	1.300
100	1.400

Regression coefficient (R^2) = 0.9968

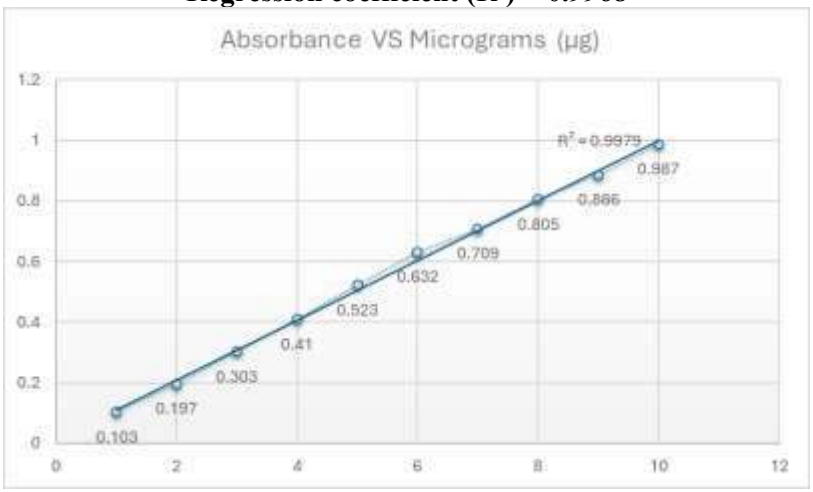

Figure 4. Calibration

Curve of Indomethacin in 2 M Urea Solution

The calibration curves followed Beer-Lambert's law over the selected concentration range,

indicating excellent linearity and suitability for quantitative estimation.

CONCLUSION

The study successfully demonstrated the application of hydrotropic solubilization for UV spectrophotometric determination of Telmisartan and Indomethacin. A 2 M urea solution effectively enhanced the aqueous solubility of both drugs without affecting their spectral characteristics. The developed methods exhibited excellent linearity, simplicity, accuracy, and reproducibility. Furthermore, the replacement of conventional organic solvents with urea represents a greener and safer analytical alternative. The proposed approach is suitable for routine pharmaceutical quality control and supports sustainable analytical chemistry practices.

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