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SIMULTANEOUS ESTIMATION OF PARACETAMOL AND IBUPROFEN IN BULK AND PHARMACEUTICAL DOSAGE FORM BY USING UV SPECTROPHOTOMETRIC METHOD

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Abstract

A simple, specific, accurate and precise UV spectrophotometric method has been developed for the simultaneous estimation of paracetamol and ibuprofen in pharmaceutical dosage form. The absorption maxima of the paracetamol and ibuprofen were found to be 240 nm and 220nm respectively using Ethanol as solvent. This method obeys Beer's law in the employed concentration range of 1-15 μ g/ml and 2-20 μ g/ml for Paracetamol and ibuprofen respectively. Different analytical performance parameters such as linearity, precision, accuracy, limit of detection (LOD) and limit of quantification (LOQ) were determined according to ICH guidelines [1,2,3]. The accuracy of the method was confirmed by recovery studies of tablet dosage form and was found to be 98.41% and 99.25% for paracetamol and ibuprofen respectively. The LOD of paracetamol and ibuprofen was found to be 0.214 μ g/ml and 0.6 μ g/ml respectively and LOQ of paracetamol and ibuprofen was found to be 0.649 μ g/ml and 0.82 μ g/ml respectively. The developed method was free from interferences due to excipients present in formulation and it can be used for routine quality control analysis.

Keywords: UV; validation.

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INTRODUCTION

Ibuprofen (IBU) chemically known as 2-[4-(2-methylpropyl) phenyl] propanoic acid (Figure 1), is an Anti-Inflammatory agent. Its pharmacological effects are believed to be due to inhibition of cyclooxygenase-2 (COX-2) which decreases the synthesis of prostaglandins involved in mediating inflammation, pain, fever and swelling [4,5].

Paracetamol (PAR) chemically known as N-(4-hydroxyphenyl)acetamide (Figure 2). It is an Analgesic and Antipyretic agent. It acts primarily in the CNS, increasing the pain threshold by inhibiting both isoforms of cyclooxygenase, COX-1, COX-2, and COX-3 enzymes involved in prostaglandin synthesis. The antipyretic properties of Paracetamol are likely due to direct effects on the heat-regulating centers of the hypothalamus resulting in peripheral vasodilatation, sweating and hence heat dissipation [6,7].

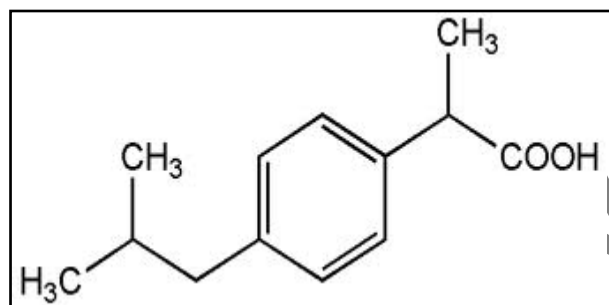


Fig. 1: Ibuprofen

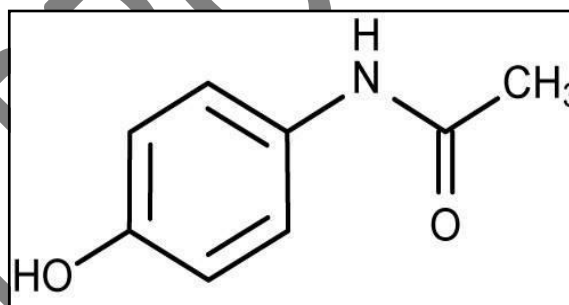


Fig. 2: Paracetamol

The combination of Ibuprofen and Paracetamol is prescribed by physician for the treatment of pain, fever and inflammation associated with musculoskeletal and joint disorders. Literature survey reveals several methods that have been used for the quantitative determination of these two drugs individually and in combination with other drugs. The objective of the work is to develop a new UV spectrophotometric method for the simultaneous estimation of Ibuprofen and Paracetamol in pharmaceutical dosage form [8-13].

MATERIALS AND METHOD

Ibuprofen and Paracetamol pure powder were gift samples supplied from Dr.Reddy's Laboratories Private Limited, Hyderabad, India. Formulation, Flexon (Label claim: Ibuprofen 400 mg and Paracetamol 500mg) was manufactured by ARISTO Pharmaceuticals Pvt. Ltd. and purchased from local pharmacy in Hyderabad, India. Shimadzu UV-Visible spectrophotometer (model UV-1800) was employed with a spectral band width of 1 nm and a wavelength accuracy of 0.3 nm (with automatic wavelength correction with a pair of 1 cm matched quartz cells).

METHOD:

SELECTION OF SOLVENT AND WAVELENGTH:

Solubility of Ibuprofen and Paracetamol was checked in solvents like ethanol, water and methanol. UV spectrum of the two drugs in these solutions was recorded. The absorbance of the three drugs was found maximum in ethanol solvent compared to other solvents and three wavelengths 220 and 240nm (Figure 3) were selected which are the λ_{max} of Ibuprofen and Paracetamol respectively.

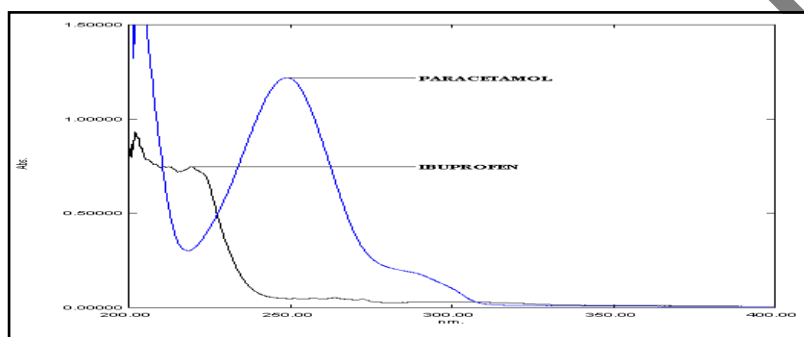


Fig. 3: Overlay spectra of Ibuprofen and Paracetamol showing selected wavelength

Preparation standard stock solutions:

Ibuprofen and Paracetamol (10 mg each) was separately weighed and transferred to 100 ml volumetric flask and all the three drugs were dissolved in ethanol to get a concentration of 100 $\mu\text{g/ml}$.

Linearity:

Calibration graph was found to be linear that is adherence to the system of Beer's law which was found over the concentration range of 2-20 $\mu\text{g/ml}$ for Ibuprofen(Figure 4) and 1-15 $\mu\text{g/ml}$ for Paracetamol (Figure 5). Absorbance and concentration was subjected to least square linear regression analysis to calculate the calibration equation and correlation coefficients. The regression data as given in Table 1, showed a good linear relationship.

Table 1: Linearity

| Parameters | Ibuprofen | Paracetamol |
|-------------------------|----------------------------|----------------------------|
| Linearity range | 2-20 $\mu\text{g ml}^{-1}$ | 1-15 $\mu\text{g ml}^{-1}$ |
| Correlation coefficient | 0.997 | 0.998 |
| Slope | 0.046 | 0.094 |
| Intercept | 0.0209 | 0.016 |

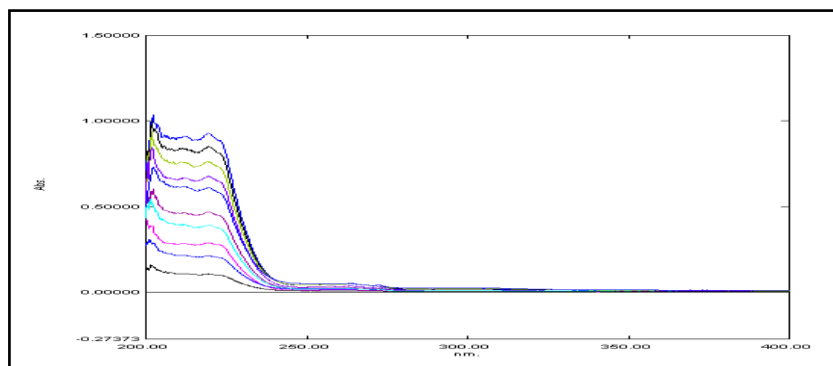


Fig. 4: Overlay spectra of standard ibuprofen (2-20 mg/ml)

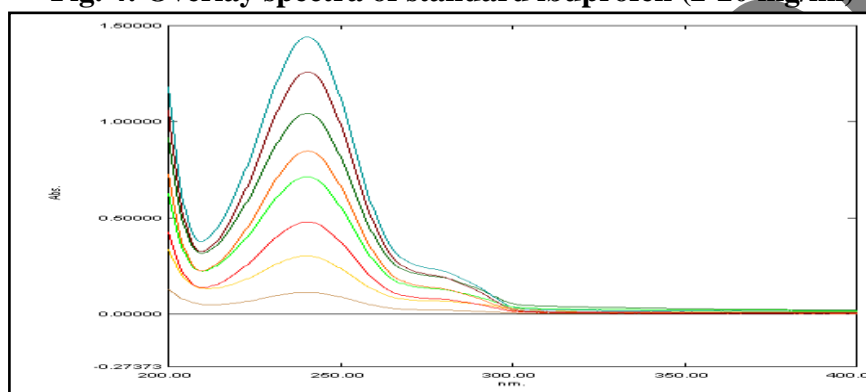


Fig. 5: Overlay spectra of standard paracetamol (1-15 mg/ml)

Precision

To check the degree of repeatability of the method, suitable statistical evaluation was carried out. The concentrations of two drugs were measured three times on the same day at intervals of 1hr and on three different days for intra and inter day study, respectively. The Relative Standard Deviation (% RSD) was found to be less than 2. The results were shown in Table 2.

Table 2: Precision Studies

| Drug | Concentration ($\mu\text{g/ml}$) | Intraday precision % *RSD | Interday precision % *RSD |
|-------------|------------------------------------|------------------------------|------------------------------|
| Ibuprofen | 10 | 1.12 | 1.41 |
| Paracetamol | 11 | 0.31 | 0.16 |

* mean of three observations

Limit of Detection (LOD) & Limit of Quantitation (LOQ)

LOD and LOQ of Paracetamol and Ibuprofen were calculated mathematically. The LOD of Paracetamol and Ibuprofen were found to be $0.214\mu\text{g/ml}$ and $0.6\mu\text{g/ml}$ respectively. The LOQ of Paracetamol and Ibuprofen were found to be $0.649\mu\text{g/ml}$ and $0.82\mu\text{g/ml}$ respectively.

Accuracy

In order to ensure the suitable and reliability of proposed method, recovery studies were carried out. To an equivalent quantity of formulation powder, a known quantity of standard Paracetamol and Ibuprofen were added at 50%, 100% level and the content were re-analyzed by the proposed method. The % recovery and % RSD were calculated. Table 3 summarizes the values.

Table 3: Recovery Studies Data of Paracetamol And Ibuprofen

| Level | %Recovery | | %RSD | |
|-------|-------------|-----------|-------------|-----------|
| | Paracetamol | Ibuprofen | Paracetamol | Ibuprofen |
| 50% | 98.33 | 98.5 | 0.1 | 0.27 |
| 100% | 98.41 | 99.25 | 0.39 | 0.23 |

Analysis of formulation

For the analysis, 20 tablets each containing 40mg of paracetamol and ibuprofen were weighed and the average weight was dissolved in ethanol and the volume was made upto get the required concentrations absorbance were noted at 240nm and 220nm (Figure 6). Table 4 summarizes the absorbance values. The amounts of paracetamol and ibuprofen were calculated using the simultaneous equation given below.

$$C_x = \frac{A_{2ay1} - A_{1ay2}}{ax_{2ay1} - ax_{1ay2}}$$

$$C_y = \frac{A_{1ax2} - A_{2ax1}}{ax_{2ay1} - ax_{1ay2}}$$

A1 = Absorbance of formulation at 240 nm

A2 = Absorbance of the formulation at 220 nm

ax1 = Absorptivity of Paracetamol at 240 nm

ax2 = Absorptivity of Paracetamol at 220 nm

ay1 = Absorptivity of Ibuprofen at 240 nm

ay2 = Absorptivity of Ibuprofen at 220 nm

Cx = concentration of Paracetamol

Cy = Concentration of Ibuprofen

Table 4: Analysis of Formulation

| Drug | Amount (mg/tablet) | | %label claim | % RSD |
|-------------|--------------------|-----------|--------------|-------|
| | Labeled | Estimated | | |
| Paracetamol | 500 | 499.5 | 99.9 | 0.53 |
| Ibuprofen | 400 | 402.05 | 100.51 | 0.95 |

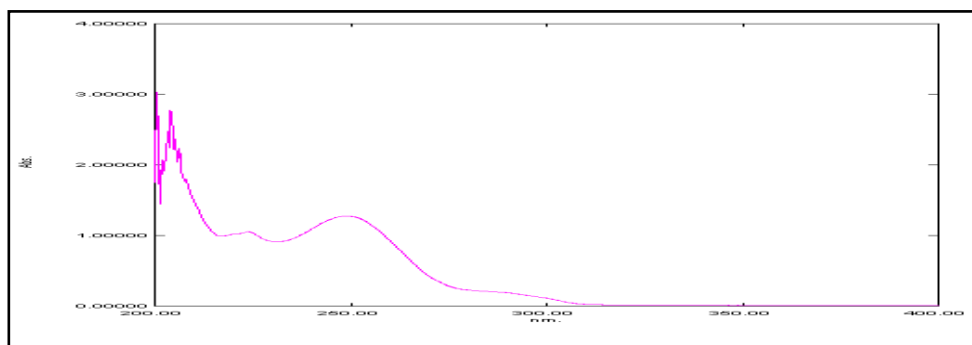


Fig. 6: Formulation Spectra of Paracetamol and Ibuprofen

RESULTS AND DISCUSSION

Estimation of paracetamol and ibuprofen was achieved by simultaneous equation method by using UV spectrophotometer. The linearity was checked in different concentrations and Beers law obeyed in the concentration range of 1-15 μ g/ml and 2-20 μ g/ml for both paracetamol and ibuprofen. The slope, intercept and correlation coefficient values of paracetamol at 240nm are 0.094, 0.016 and 0.998. The slope, intercept and correlation coefficient values of Ibuprofen at 220nm are 0.046, 0.0209 and 0.997. The recovery studies were carried out to ensure the reproducibility and reliability of the method by adding known amount of standard drugs and analysis was carried out as per formulation procedure.

CONCLUSION

The developed UV spectrophotometric method is simple, precise, accurate, linear, reproducible and repeatable for the estimation of Ibuprofen and Paracetamol in pharmaceutical dosage forms without any interference from the excipients. It can be successfully applied for the routine analysis of both the two drugs in pharmaceutical dosage forms.

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