Simultaneous spectrophotometeric determination of Ibuprofen and paracetamol by absorbance difference method

L.K. OMRAY[1], SHAILENDRA PATIL[2] and ASMITA GAJBHIYE[3]

[1]Guru Ramdas Khalsa Institute of Science and Technology (Pharmacy), Jabalpur (India).
[2]Globus College of Pharmacy, Bangrasia, Bhopal (India).
[3]Department of Pharmaceutical Sciences, Dr. H.S. Gour Vishwavidyalaya, Sagar (India).

ABSTRACT

A spectrophotometeric method for the simultaneous and separate estimation of ibuprofen and paracetamol in binary tablet formulation has been developed. This method based on the estimation of one drug in presence of another drug by absorbance difference method. The ibuprofen and paracetamol solution were scanned over a range of 200 to 600 nm. In this method, two wavelengths 220nm and 231nm were chosen for ibuprofen and at these wavelengths the absorbance difference was almost zero while there was considerable absorbance difference in case of paracetamol, similarly. The two wavelengths 241nm and 255nm were chosen for paracetamol and at these two wavelengths, absorbance difference was almost zero while there was considerable absorbance difference in case of Ibuprofen. In the mixture of ibuprofen and paracetamol solution absorbance values of four wavelengths 220nm, 231nm, 241nm and 255nm were measured. The amount of ibuprofen was directly proportional to the absorbance difference between 241nm and 255 mm. Similarly, the amount of paracetamol was directly proportional to the absorbance difference between 220nm and 231 nm.

Keywords: Ibuprofen, Paracetamol, Simultaneous determination, Absorbance difference.

INTRODUCTION

The combined formulation of ibuprofen and paracetamol are available in the market. Both drugs belong to non-steroidal anti-inflammatory category that possesses analgesic, anti-inflammatory, and antipyretic activity by reducing prostaglandin syntheses[1, 2, 3]. Fixed combination of ibuprofen and paracetamol (400mg and 325mg) is marketed as tablet formulation for the symptomatic relief of pain and fever.

Various methods for the estimation of ibuprofen and paracetamol separate[4] and in combination with other drug like veldecoxib[5], chlorzoxazone[6], dextropropoxyphen hydrochloride[7], methocarbamol[8] etc. reported, but simultaneous estimation of ibuprofen and paracetamol is not so far reported literature.

The objective of the present investigation was to develop a simple, rapid, precise, reproducible and economical method for the simultaneous analysis of the binary drug formulation by using absorbance difference method without any interference from each other.

MATERIAL AND METHODS

A Chemito's Spectrascan UV 2600 spectrophotometer with 10mm quartz cells are used for the absorbance values of the drug solution. Ibuprofen and paracetamol were obtained as gift samples from Guapha pharmaceuticals, Jabalpur, (M.P.). All the chemicals used were of analytical grade and ethanol was used as solvent.

Preparation of Standard Ibuprofen Solution

Pure ibuprofen (100mg) was dissolved in ethanol (100mL). Above stock solution (1mL) was

further diluted to 50mL with ethanol to get working concentration of 20µg/mL.

Preparation of Standard Paracetamol Solution

Pure paracetamol (100mg) was dissolved in ethanol (100mL). Above stock solution (1mL) was further diluted to 50mL with ethanol to get working concentration of 20µg/mL.

Preparation of Mixed Solution

Two Solutions, the first containing 20µg/mL of ibuprofen and the second containing 20µg/mL of paracetamol were used as mixed solution, four mixed standard solutions were made by taking 4, 3, 2 and 1 mL of ibuprofen solution in the series of test tubes and paracetamol stock solution were added into the series of test tubes to keep the total volume of 5mL.

Preparation of Calibration Curve

Various aliquots (3, 4, 5 and 6 mL) of ibuprofen stock solution (20µg/mL) were transferred in the series to 10mL volumetric flask and the volume of each flask was adjusted to 10mL with ethanol. The absorbance of these solutions are scanned over the range of 200 to 600 nm. An overlain spectrum of ibuprofen is shown in Fig. 1. Again various aliquots of paracetamol solution (20µg/mL) were transferred into a series of 10mL volumetric flask and the volume in each flask was adjusted to 10mL with ethanol. These solutions were scanned over the range of 200 to 600 nm. An overlain spectrum of paracetamol is shown in Fig. 2. Two wavelengths 220 and 231nm were chosen for ibuprofen and at these two wavelengths the absorbance difference value were almost zero, while paracetamol at the same wavelengths had maximum absorbance difference value.
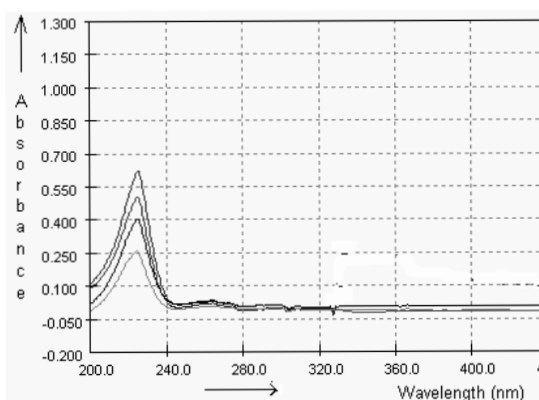

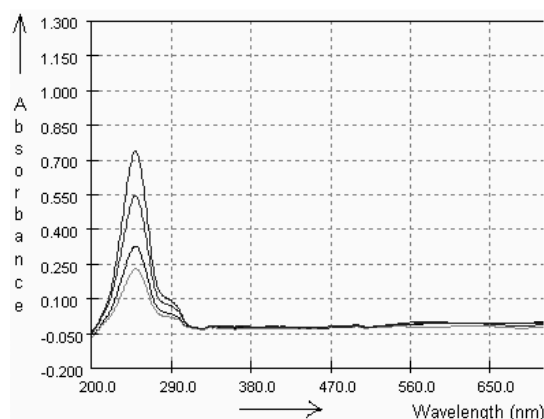**Fig. 1. Overlain spectra of ibuprofen**

Fig. 2. Overlain spectra of paracetamol

A calibration curve was drawn between absorbance difference value of paracetamol and the amount of paracetamol in µg/mL. The amount of paracetamol present in the sample was computed from calibration curve. Similarly, two wavelengths 241 and 225 nm are chosen for paracetamol and at these two wavelengths, absorbance difference were almost zero, while ibuprofen at the same wavelengths had maximum absorbance difference value. A calibration curve was drawn between absorbance difference value of ibuprofen and amount of ibuprofen in µg/mL. The amount of ibuprofen present in the sample was computed from calibration curve. Various aliquots of mixture of

ibuprofen and paracetamol solution in different proportions were transferred in to a series of test tubes and the volume in each test tube was made up to 5mL with distilled water. The absorbance values were measured at two wavelengths 241 and 255 nm for estimation of ibuprofen and at two wavelengths 220 and 231nm for estimation of paracetamol. A calibration curve was drawn between the absorbance difference values of ibuprofen and the amount of ibuprofen present in µg/mL. A calibration graph was drawn between the absorbance difference values of paracetamol and the amount of paracetamol present in µg/mL. A linear curve in each case was obtained. The linearity

of the curves indicates that it obeys Beer's law and the suitability of this method for the simultaneous determination of the drugs in admixture.

Estimation of Ibuprofen and Paracetamol in Pharmaceutical formulation

Twenty tablets were weighed and powdered. An average weight of the tablets containing the two drugs, Ibuprofen and paracetamol in the ratios of 4: 3.25 which contain 400mg of ibuprofen and 325mg of paracetamol was dissolved in 100mL of ethanol by vigorous shaking and the volume was made up to the mark. The solution was then filtered through whatman filter paper no. 41 and the solution was diluted to get a final concentration of approximately 8µg/mL ibuprofen and 6.5µg/mL of paracetamol. The absorbance of sample solutions were measured at 241 and 255nm for ibuprofen and 220 and 231nm for paracetamol in the Chemito's Spectrascan UV 2600, spectrophotometer. The results are represented in Table 1.

Validation of Method

The method was validated in terms of linearity, accuracy, precision, specificity and reproducibility of the sample applications. The linearity of the method was investigated by serially diluting the stock solution of ibuprofen (20µg/mL) and paracetamol (20µg/mL) and measured the absorbance values at 241 and 255mm for ibuprofen and 220 and 231mm for paracetamol using Chemito's Spectrascan UV 2600, spectrophotometer. Calibration curves were constructed by plotting the absorbance differences

values against the amount of drug in µg/mL.

Recovery Experiment

To ensure the accuracy and reproducibility of the results obtained, recovery experiments were performed by adding a known amount of standard drug to previously analyzed pharmaceutical preparations. The results are recorded in Table 1.

RESULT AND DISCUSSION

The present study was carried out to develop a simple, rapid, sensitive, precise, reproducible and accurate spectrophotometric method for the estimation of simultaneous determination of ibuprofen and paracetamol in pharmaceutical dosage form. The proposed absorbance difference method was simple, less time consuming, economic and found to be one of the best versatile analytical technique employed for routine analysis purpose like assay of pharmaceutical formulations. The contents of ibuprofen and paracetamol in three different tablet dosage forms are shown in Table1. The absorbances of various aliquots of mixture of ibuprofen and paracetamol solution were measured at two wavelengths 241 and 255nm for ibuprofen and 220 and 231nm for paracetamol. A calibration curve was drawn between the absorbance differences of ibuprofen against the amount of ibuprofen in µg/mL. The amount of ibuprofen present in the sample was computed from calibration curve. Similarly, for the estimation of paracetamol, a calibration curve was plotted between the absorbance difference values of paracetamol

Table 1: Estimation of Ibuprofen and Paracetamol in Pharmaceutical Preparations

S. No.	Label Claim (mg/tab.)		Drug content* by proposed method (mg/tab.)		% Recovery*	
	IBU	**PARA**	**IBU**	**PARA**	**IBU**	**PARA**
P_1	400	325	394	321	99.1	98.8
P_2	400	325	388	332	98.6	99.2
P_3	400	325	386	319	98.2	100.4

*Average of three determinations based on the lebel claim
IBU-Ibuprofen; PARA-Paracetamol
P1 to P3= IBU/PARA combination product of different company

against the amount of paracetamol in µg/mL. The amount of paracetamol present in the sample was calculated from calibration curve.

The results obtained by proposed method were in good agreement with the labeled claim. The additives present in the tablets did not interfere, as a check on accuracy of the method, recovery experiment was performed and percent recovery values were also tabulated Table 1. The statistical analysis was studied by proposed method and results are tabulated in Table 2. The values of standard deviation and coefficient of variation values were satisfactorily low, that indicate accuracy and reproducibility of the method.

In conclusion, the results indicate that the proposed absorbance difference method was found to be simple, rapid, precise, highly accurate and less time consuming. Hence, it can be used for the routine analysis of simultaneous determination of ibuprofen and paracetamol in pharmaceutical formulation.

Table 2: Statistical Analysis of Estimated Ibuprofen and Paracetamol

S. No.	Label Claim (mg/tab.)		*Standard deviation		* Coefficient of Variation	
	IBU	PARA	IBU	PARA	IBU	PARA
P_1	400	325	1.01258	0.99438	0.2936	0.2826
P_2	400	325	0.94325	1.12657	0.2578	0.2967
P_3	400	325	0.94683	0.93021	0.2417	0.3146

*Average of three determinations based on the label claim
IBU-Ibuprofen; PARA-Paracetamol
P1 to P3 = IBU/PARA combination product of different company

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