ORIGINAL ARTICLE

The Simultaneous Determination of Ibuprofen and Paracetamol in Pharmaceutical Formulations by High-performance Liquid Chromatography with Ultraviolet Detection

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HIGHLIGHTS

- A new method of estimating ibuprofen and paracetamol in pharmaceutical formulations.
- Use of high-performance liquid chromatography- ultraviolet technology for LC100 in the estimation of ibuprofen and paracetamol in pharmaceutical formulations.
- Study the stress degradation for ibuprofen and paracetamol in pharmaceutical formulations in the neutral, acid, and base media.
- Studying the relative stability of ibuprofen and paracetamol in pharmaceutical formulations during the experimental estimation process.
- Perform different applications for the purpose of validating the chromatographic method in the estimation of the Ibuprofen and paracetamol in pharmaceutical formulations.

Abstract

Context: In this manuscript, high-performance liquid chromatography technology equipped with ultraviolet detector has been developed that it has the sensitivity, accuracy, and high reliability for the simultaneous identification of the ibuprofen (IB) and paracetamol (PA). **Methods:** Chromatographic separation was achieved on Ion Pac column; Arcus EP-C18 (5 µm, 4.6 mm × 250 mm) by a mobile phase consisted of acetonitrile and water (30:70, v/v)+40 mmol/L phosphate buffer at pH 6.0 with a flow rate of 1.0 mL/min. The detection wavelength was set range at 300–330 nm. The IB and PA were subjected to different forced degradation conditions. In all the conditions, the degradation products were well obtained from the peaks of IB and PA. The method was linear at a concentration range of 5–25 µg/mL (R^2 = 0.9987) and 1–5 µg/mL (R^2 = 0.9989) for the IB and PA, respectively. **Results:** The limit of detection (LLOD) was 0.0133 µg/mL and limit of quantitation (LLOQ) was 0.0420 µg/mL for IB and the LLOD was 0.0213 µg/mL and LLOQ was 0.0521 µg/ml for PA, respectively. The precision of the method was satisfactory; the relative standard deviations values did not exceed 1%. The accuracy of the method was proved; the mean recovery was in the range of 99.88%–100% for the IB and in the range 98.99–101.0% for the PA. **Conclusion:** The developed and validated method was applied successfully for the assay of the IB and PA in combined tablet dosage with good precision and accuracy.

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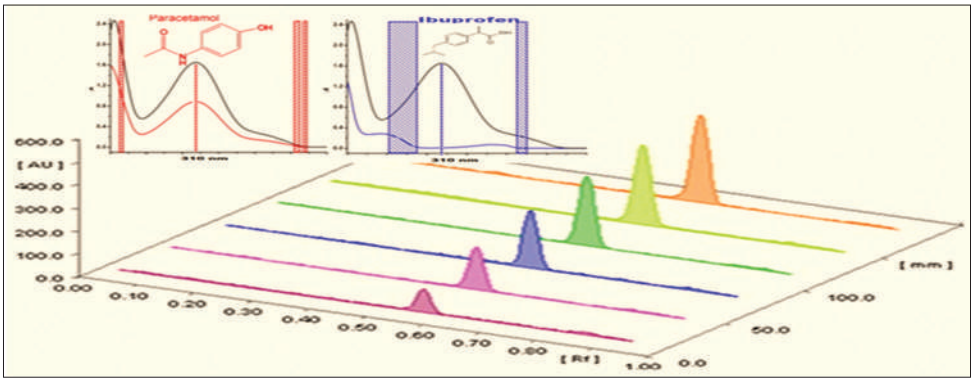
Graphical abstract



Keywords: Ibuprofen, degradation conditions, paracetamol, ultraviolet detection

INTRODUCTION

The study of the simultaneous estimation of the ibuprofen (IB) and paracetamol (PA) requires first to know the physicochemical properties of each of these materials and to know the structural and spectral formulas of each.

IB [Figure 1] is a nonsteroidal anti-inflammatory drug marketed under various brand names such as advil, used for the tooth pain, arthritis, primary menopause, and fever, especially in cases of inflammation. The formula was $C_{13}H_{18}O_2$, IUPC ID: [(RS)-2-(4-(2-) methylpropyl)phenyl)propanoic acid], the solubility in water: (20°C) 0.021 mg/ml, the boiling point: 157°C at 4 mmHg, and the density: 1.03 g/cm^3.[1]

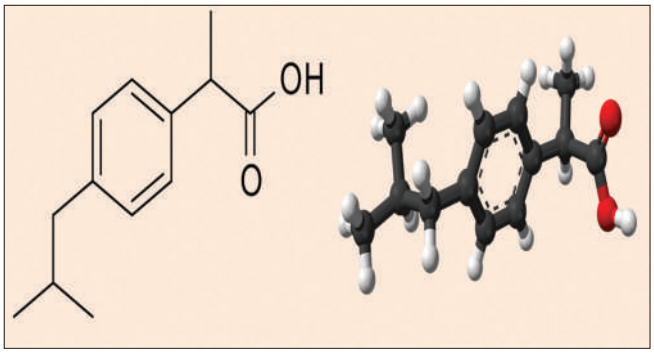


Figure 1: Structure of ibuprofen

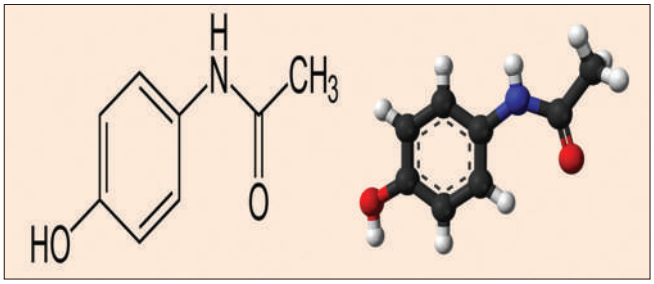


Figure 2: Structure of paracetamol

PA or acetaminophen [Figure 2], the US-approved name, is a widely used pain relief and antipyretic. Extract from tar and it is an active metabolite of phenacetin. In contrast to Phenacetin, PA did not appear as to be carcinogenic in any form. The Formula: $C_8H_9NO_2$, boiling point: (420°C), IUPC ID: N-(4-hydroxyphenyl) ethanamide, N-(4-hydroxyphenyl) acetamide.[2]

A number of studies and literature mentioned the precise description of the simultaneous estimation of the IB and PA. An extensive study was conducted to determine the type and quantity of these substances in pharmaceuticals. The study was done by the chromatographic separation method using the detector of ultraviolet (UV) ray for the purpose of the chemical analysis of pharmaceuticals.[3-5]

The simultaneous determination of the IB and PA requires knowledge of the various physicochemical properties, then the optimal conditions for the separation, and estimation process for pharmaceuticals. The use of the high-performance liquid chromatography (HPLC) method using a UV detector has greatly assisted in the determination of the components of substances in pharmaceuticals in general.[6-8]

The high level of confidence, sensitivity, and selectivity using the HPLC method makes this technique one of the most popular separation techniques that were used in the estimation of pharmaceuticals. Pharmacopeia USA recommends using HPLC separation techniques in a system of analysis of pharmaceutical samples, especially when the compound that consists of a number of substances that intervention in the composition of the pharmaceutical product. HPLC technology is of great importance because it is a sensitive and credible technology and does not require additional time spent in the analysis. Furthermore, this technique does not consume quantities of chemical materials for a specific routine analysis and the lack of waste during analyzing samples with increasing number of samples that are analyzed.[9,10]

The LC100 electron spectrometry is sufficient for the simultaneous analysis of both the IB and PA, either for IB alone or for both IB and PA. The use of spectra for the LC100 system by integrated electronic scanning programs. The integration diodes give accuracy results in the estimation of both the IB and PA.

In this study, optimal conditions for the separation and determination of IB and PA are determined using HPLC-UV technology within a spectral wavelength at range 300–330 nm. HPLC technology can be cited as a successful technique through the obtained results characterized by success, accuracy, high sensitivity, and low quantities of materials to be analyzed. The speed of the analysis process as well as the lack of time for analysis HPLC-UV technology has become one of the most widely used methods, especially when analyzing IB and PA samples in their raw pharmaceuticals.[9.11-14]

The objective of the study

The objective of the study was to develop and verify the reverse phase-HPLC (RP-HPLC) method with a UV detector for simultaneous determination of the IB and PA samples in the raw pharmaceuticals.

EXPERIMENTAL

HPLC-UV analysis

The LC-100 series S-HPLC features fully automatic digital computer control. Its electronic circuit design, internal mechanical structure design, processing technology, functions of cinematography workstation, and the technical criteria make it a leading instrument with excellent stability and reliability. Apparatus consisted of USA HPLC that classes LC series. The LC-100 equipped with double-beam UV-visible spectrophotometer (Angstrom Advanced Inc., USA), model UV-100 PC with 1 cm path length quartz cell is used and it is connected of IBM compatible computer. The software UV-PC of personal spectroscopy software version Matlab, R2003b, was used of the proposed chemometric methods, and the partial least squares (PLS) was performed with PLS_Tool box for use with Matlab R2003b, VP pumps, and variable wavelength programmable UV detector. Peak areas were integrated using Angstrom Advanced Inc., LC solution software program. The chromatographic separation and quantification were performed on Ion Pac column; Arcus EP-C18; (250 mm × 4.6 mm; particle size 5 µm) analytical column at room temperature. The mobile phase was used as standard drug solutions. The tablet sample solutions were filtered through a millipore membrane filter before injection into the HPLC system.[15-17]

Chemicals and reagents

Data and methodology

The acetonitrile of the class HPLC grade was procured from Merck Ltd., Germany. Two drugs as a synthetic mixture, containing IB and PA, were purchased from AARTI Drug Industries Pharma, India, and Rameda Pharma (Limited Tenth®). All other chemical reagents were of high analytical purity grade.

The standards materials of the IB and PA that has purity 98% and 99% respectively, according to manufacturer certificate and were kindly donated by AARTI Drug Industries Pharma, India, for medical devices and pharmaceuticals.

Market sample

Ibuprofen-Razifen tablets, batch No. 180512, were labeled to contain 200 mg IB and 500 mg PA per tablet and were manufactured by ElRazy Pharmaceutica NV® for Pharmaceuticals and Medical Appliances; the other drug Megafen® tablets, batch No. 180555, were labeled to contain 200 mg IB and 325 mg PA per tablet, it was manufactured by Rameda Pharma (Limited Tenth®) for Pharmaceuticals and Medical Appliances.

THE WORKING PROCEDURE

Configure the samples for measurement

- HPLC grade solutions (Sigma-Aldrich® Chemie GmbH, Germany).
- Stock standard solutions for IB and PA were prepared in mixture from acetonitrile and water (30:70, v/v)+40 mmol/L phosphate buffer at pH 7.0 to prepare concentration of 1 mg/ml from IB and PA.[18,19]
- Working standard solutions for IB were prepared in mixture from acetonitrile and water (30:70, v/v)+40 mmol/L phosphate buffer at pH 6.0 to prepare the concentration (5.0, 10.0, 15.0, 20.0, and 25.0) µg/ml for IB and (1.0, 2.0, 3.0, 4.0, and 5.0) µg/ml for PA.

Sample updating

To perform sample updating, the optimized PLS calibration set was augmented with different samples of Razifen tablets® containing known amounts from standard IB-200 mg and PA-500 mg. Megafen® tablets containing known amounts from standard IB-200 mg and PA-350 mg were manufactured by Rameda Pharma (Limited Tenth®). One known concentration to five unknown concentrations of samples containing different concentrations of each were added purpose for doing the initial calibration, and the predictive ability of the updated sample was checked using external validation samples. The standard additions method was

used to calculate the unknown concentration of commercial pharmaceuticals where five standard concentrations were added to the concentration of the unknown of the sample.[20-24]

RESULTS OBTAINED

Chromatographic conditions

Table 1 shows the values of the basic parameters obtained using the RP chromatography system (RP-HPLC).

Mean centering of ratio spectra method

Calibration curve

The standard calibration curves of the proposed method were prepared over concentration ranges of 5–25 µg/mL for the IB and 1.0–5.0 µg/mL for PA. Each solution was prepared in triplicate and 20 µl of each solution was injected into the column. The calibration peaks were determined at the wavelength of 260 nm. The calibration curves of the IB and PA were constructed by the relationship plotting of the peak area versus concentrations.[25]

PLS sample to calibration curve

Figure 3 shows the use of a multidesign calibration curve for a number of concentrations for the purpose of verifying the estimation and measurement method. Five concentrations were used for each sample of IB separately and PA separately and five concentrations of a combination of IB and PA. Absorption spectra were studied within the wavelength range of 300–330 nm. A number of calibration curves were recorded for the IB alone and PA alone as well as for the mixture for the purpose of forming several designs for the standard calibration curves.[26]

Laboratory prepared mixtures

The calibration curves prepared in the laboratory contain different percentages of IB and PA. The absorbance spectra of each of them were individually recorded for both IB and PA and in mixtures of IB and PA together with different concentrations that show in Figures 4 and 5.

Table 1: Parameters of RP-HPLC method

Column	Ion Pac column; Arcus EP-C18; 5µm, 4.6×250 mm)
Mobile phase	Acetonitrile: water 30:70 (v/v)] + 40 mmol/L phosphate buffer at pH 6.0
Flow rate	1.0 mL/min
Detection wavelength	At range 300–330 nm
Column temperature	Room temperature
Injection volume	20 µL
Run time	3.30 and 3.53 min

RP-HPLC: Reverse phase high-performance liquid chromatography

Assay of IB and PA in tablets

Five consecutive (n = 5) concentrations of 20 µl of the tablet solution (IB 15 µg/ml and PA 3 µg/ml) were injected into the HPLC system. Medicinal areas were determined at a 310 nm wavelength. The concentration of drugs in the tablets was determined either from the corresponding calibration curve or from the corresponding regression equation, Figure 4.

Assay of validation set

The five laboratory mixtures (No. 3, 6, 10, 15, and 20) [Table 2] were selected to be used as external verification samples, and the procedure described in the calibration samples was followed. The concentrations of each component were calculated using the enhanced calibration sample PLS.

The concentrations of 100 mg and 50 mg were separately converted to 100 ml of the calibration flask, and 100 mL of methanol was added. The solution was left for 20 min, and the solution was then filtered from the precipitators and plankton. Appropriate dilution of solutions for the preparation

Table 2: Concentrations of IB and PA in the calibration and validation sets

Sample Number	IB µg/mL	PA µg/mL
1	7	2
2	7	2
3	5	1
4	9	3
5	10	3
6	10	2
7	11	4
8	9	4
9	12	3
10	15	3
11	8	4
12	12	2.5
13	16	3
14	24	4
15	20	4
16	24	3
17	28	6
18	27	6
19	26	5
20	25	5

IB: Lbuprofen, PA: Paracetamol

of working solutions (15 µg/ml) of IB and PA concentration (3.0 µg/ml) was performed.[27]

STRESS DEGRADATION STUDIES

Stress degradation studies were carried out using different ICH prescribed stress conditions such as acidic, basic, oxidative, thermal, and photolytic stresses.[28,29]

Acid degradation

Tablets' powder equivalent to 15 mg of the IB and 3 mg of PA was taken in 100 mL volumetric flask. 5 mL of 0.1 N HCl was added to the flask and kept at 80°C reflux conditions for 2–3 h. After completion of the stress, the solution was neutralized using 0.1 N NaOH and completed up to the mark with mobile phase.

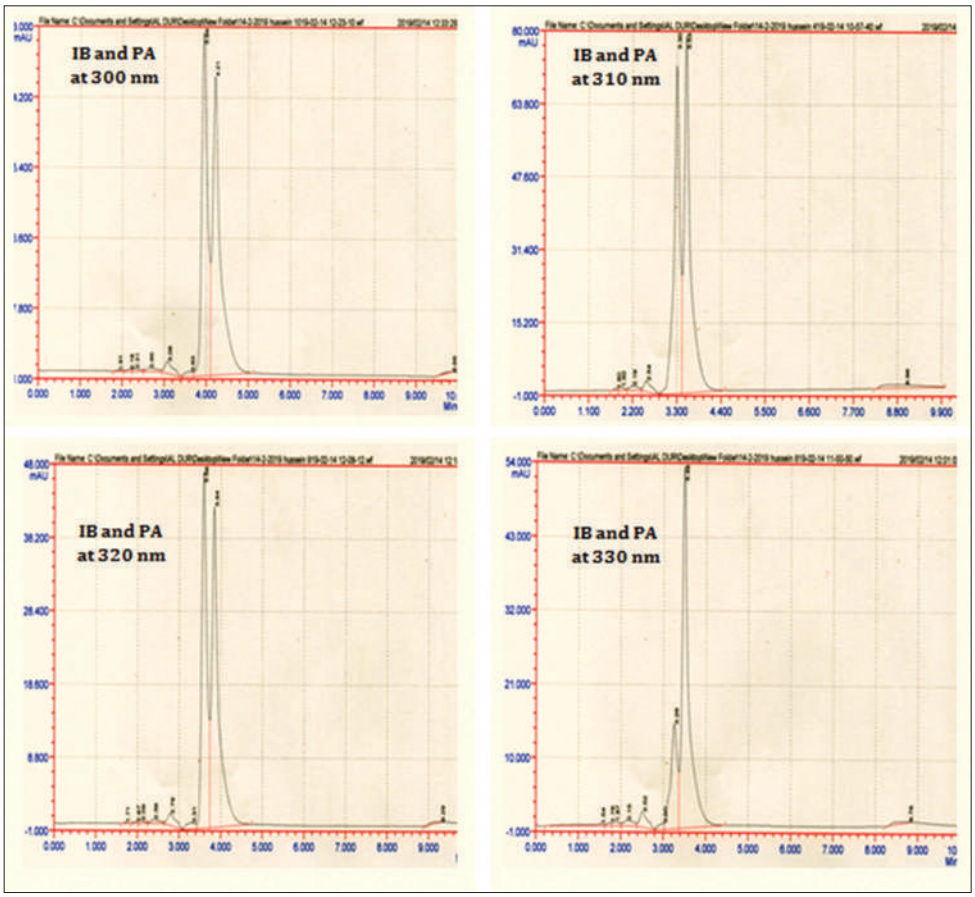


Figure 3: Partial least squares for a multidesign calibration curve for standard calibration curve for ibuprofen and paracetamol, except: Column, Ion Pac column; Arcus EP-C18; 5 µm, 4.6 mm × 250 mm; wavelength 300–330 nm; a mobile phase consisted of acetonitrile and water (30:70, v/v) + 40 mmol/L phosphate buffer at pH 6.0 with a flow rate of 1.0 mL/min, standard concentrations: 5–15 µg/ml and 1–5 µg/ml for IB and PA, respectively; injection volume: 20 µL

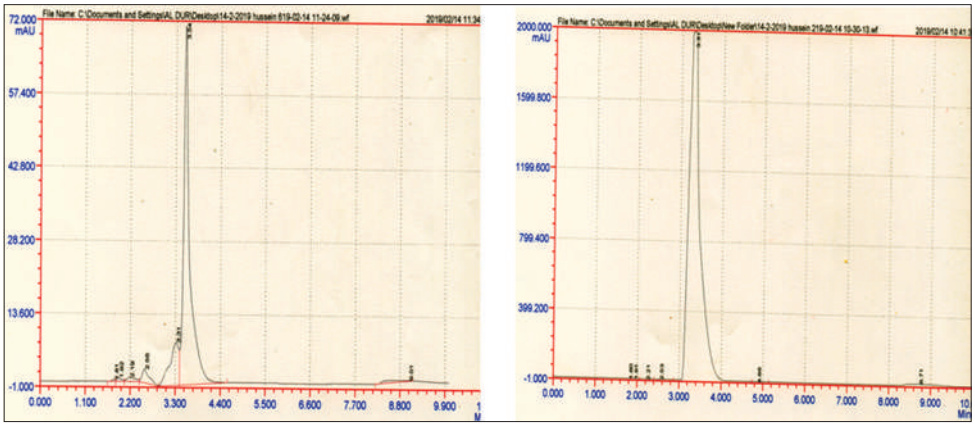


Figure 4: Standard calibration curve for ibuprofen IB alone and paracetamol alone

Base degradation

Tablets' powder equivalent to 15 mg of the IB and 3 mg of PA was taken in 100 mL volumetric flask. 5 mL of 0.1 N NaOH was added in the flask and kept at 80°C reflux conditions for 2–3 h. After completion of the stress, the solution was neutralized using 0.1N HCl and completed up to the mark with mobile phase.

Oxidative degradation

Tablets' powder (equivalent to 15 mg of the IB; 3 mg of PA) and 5 mL of 20% H_2O_2 was added in 100 mL volumetric flask. The flask was kept at 80°C reflux conditions for 2–3 h. After completion of the stress, the flask was completed up to the mark with mobile phase.

Thermal degradation

In this operation, tablets' powder (equivalent to 15 mg of the IB and 3 mg of PA) was taken in glass Petri dish and placed in hot air oven at 105°C for 2–3 h. After specified time, the tablet powder was transferred to a 100 mL volumetric flask and made up to the mark with mobile phase.

Table 3: Parameters of the system suitability

Parameters	Value of the parameters	Recommended limits
Retention time for IB	3.3 (%RSD 0.499)	RSD ≤ 1
Peak area for IB	74543.6 (%RSD 0.432)	RSD ≤ 1
USP plate count for IB	2071	~2000–2500
USP tailing factor for IB	0.68	≤ 2-2.5
Resolution for IB	0.23 min	≥2
Retention time for PA	3.532 (%RSD 0.362)	RSD ≤ 1
Peak area for PA	87337.5 (%RSD 0.300)	RSD ≤ 1
USP plate count for PA	2056	~2000–2500
USP tailing factor for PA	5.33	≤ 2-2.5
Resolution for PA	0.23 min	≥2

IB: Lbuprofen, PA: Paracetamol, RSD: Relative standard deviation

Photolytic degradation

For photolytic degradation study, the tablets' powder with equivalent to 15 µg of the IB and 3 µg of PA was transferred into a glass Petri dish and placed in the direct sunlight for 2–3 h. After completion of the stress, the tablets' powder was transferred to a 100 ml volumetric flask and make up to the mark with mobile phase.

DISCUSSION OF THE RESULTS

The optimization of HPLC conditions

The chromatography conditions have been developed to separate all degradation products for IB and PA. During the RP-HPLC-UV method improvement, several experiments were performed using the Ion Pac Arcus EP-C18 column. 5 µm, 4.5 mm × 250 mm, with appropriate mobile phase use consisting of acetonitrile and water (30:70, v/v) + 40 mmol/L phosphate buffer at pH 6.0 with a flow rate of 1.0 ml/min. Wavelength was recorded at 310 nm. The retention time was 3.30 min for IB and 3.53 min for PA. The form of good peaks was noted for the new analytical method [Figures 4 and 5].

The system suitability

A number of studies have been carried out for the purpose of adapting the RP-HPLC-UV system to the analysis of various IB and PA concentrations. The standard IB (15 µg/ml) and PA (3 µg/mL) were used in five replicas (n = 5) of the same concentrations that were replicated using the optimal method. Table 3 shows the system's adequacy parameters. These results meet the requirements of the separation method for IB and PA estimates in various pharmaceuticals.[30,31]

The validation of method and assay

In accordance with the ICH guidelines, the new chromatographic method HPLC-UV and the parameters

Table 4: Results of method robustness

Parameter	Robustness of IB and PA			
	Claimed Concentration (µg ml^{-1})	Found (µg/mL)	% Recovery	%RSD
Column for IB and PA	10	10	100.0	0.512
System for IB and PA	10	10	100.	0.554
Analyst IB	15	14.7	98.0	0.478
Analyst PA	3	2.8	93.3	0.300

IB: Lbuprofen, PA: Paracetamol, RSD: Relative standard deviation

such as specificity, linearity range and sensitivity, regression, precision, accuracy, and rigidity were used to validate the method used. To assess the method validity, the effect of experimental conditions on the peaks areas for the analyzed materials was examined. The validity of the method was checked at a concentration of 15 µg/mL for IB and 3 µg/ml for PA. Table 4 summarizes all the results. The results revealed that the peak areas for the drugs were unaffected small changes in flow rate, composition of mobile phase, temperature, and detection wavelength indicating significant validity of the method.[32,33]

The specificity[34]

The specificity of the proposed method was studied using the study of forced degradation. The analysis was performed to ensure that the proposed method was able to separate IB and PA from the potential degradation products generated during the study of forced degradation. Studies were performed using acid, base, oxidation, photolysis, and heat for the tablet sample at a concentration of 15 µg/ml of IB and 3 µg/ml for PA. Table 5 shows the results of forced decomposition. The highest percentage of deterioration occurred under the alkaline conditions of the drug. The lowest percentage of degradation for IB and PA occurred in the case of thermal and in the case of sunlight. One peak degradation was observed in decomposition products. Other degradation products due to stress do not interfere with the detection for IB and PA, so the method can be considered as an indicator of stability. The chromatograms are shown in Figures 6-10.

The linearity range and sensitivity[35,36]

Under the optimum experimental conditions, a linear relationship was established by plotting the peaks areas for drug against the drug concentration (µg/mL). The concentration range was found to be 5–25 µg/mL for IB and 1–5 µg/ml for PA. The linear regression analysis of the data gave from the following equations:

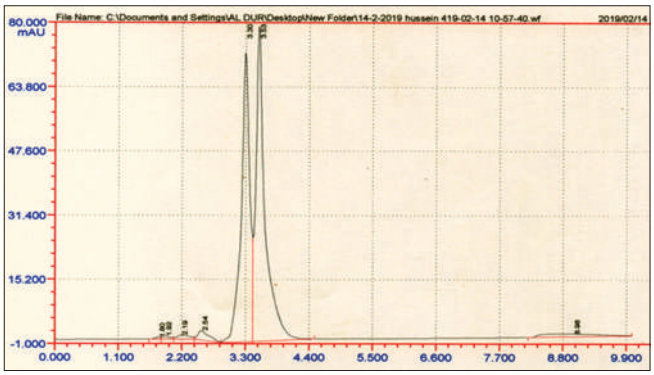


Figure 5: Standard calibration curve for Ibuprofen and paracetamol

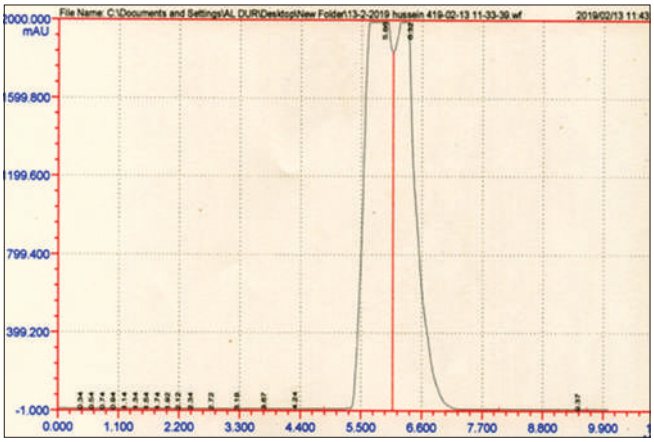


Figure 6: Chromatogram of acid degradation

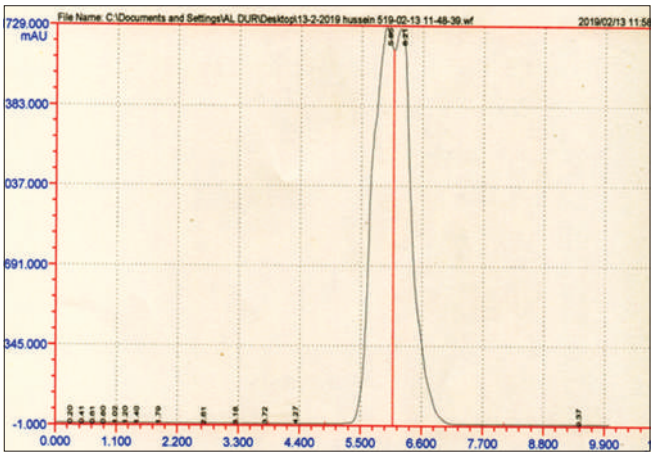


Figure 7: Chromatogram of base degradation

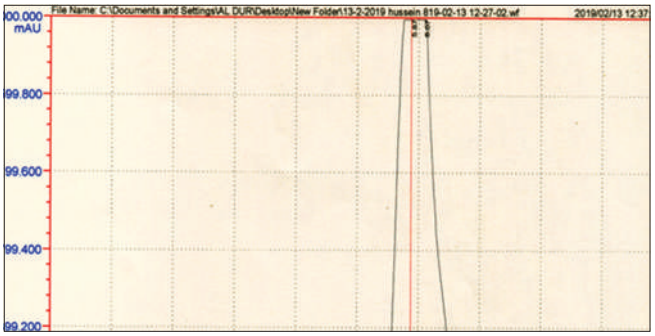


Figure 8: Chromatogram of oxidative degradation

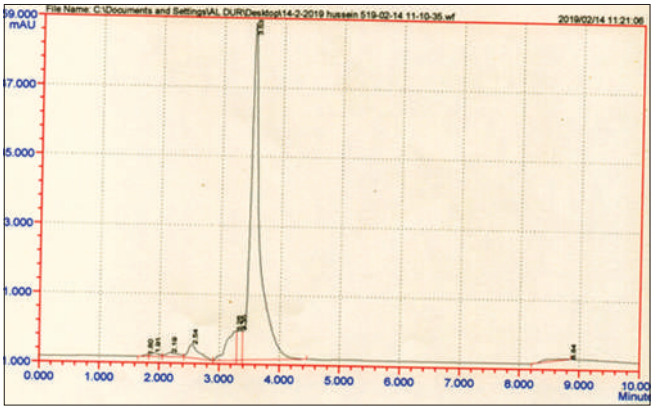


Figure 9: Chromatogram of thermal degradation degradation

y = 104125x + 755.8 (R^2 = 0.9987) for IB

y = 155017x + 620.2 (R^2 = 0.9989) for PA

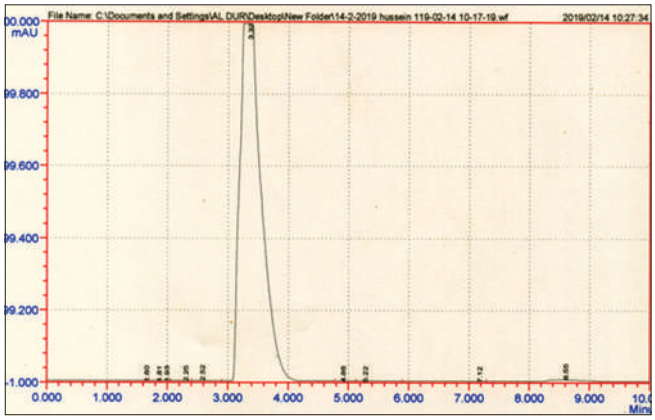


Figure 10: Chromatogram of thermal degradation degradation

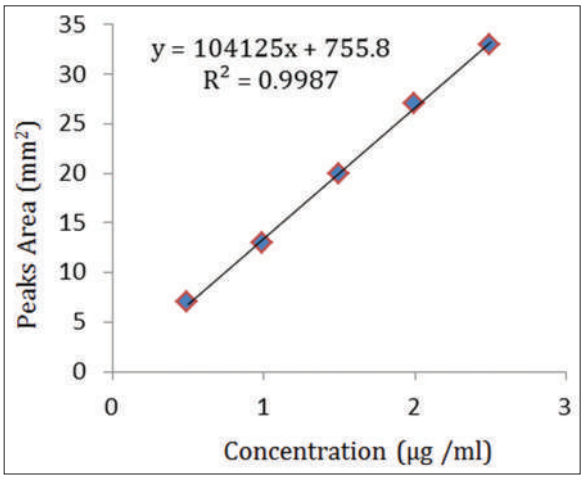


Figure 11: Linearity of the calibration curve for ibuprofen

On the assumption that: y = peak area, x= concentration of the drug (µg/mL), and R^2 = regression coefficient. The high values of regression coefficients with small intercept indicate the good linearity of the calibration curve as shown in Figures 11 and 12.

The regression[37]

The sensitivity of the proposed method was assessed by calculating limit of quantitation (LLOQ) and limit of detection (LLOD). The LOD and LLOQ were calculated as follows:

LLOQ=10×SD/S; LLOD=3.3×SD/S

Where SD= standard deviation of the drug response and S= slope of the calibration curve. LLOD values were found to be 0.0133 µg/ml for IB and 0.0213 for PA, while LLOQ values were found to be 0.0420 µg/ml for IB and 0.0521 for PA. These values demonstrate the satisfactory sensitivity of the proposed method for the analysis of selected drug, Table 6 shows the results of regression statistics of the proposed method.

The accuracy[38]

For the pre-analysis tablet sample solutions, a known amount of standard solution was added at three different levels, 10%, 20%, and 30%. The solutions were reanalyzed by the proposed method. The results of studies were the % recovery was between 99.88% and100% with % relative standard deviation (RSD%) ≤0.5% for IB and 98.99–100% with RSD% ≤4 for PA. The results indicate good accuracy of the method. The selectivity of the method was demonstrated by the non-interferences of the excipients during analysis of the IB and PA. The results are summarized in Table 7.

Table 5: Results of forced degradation studies

Type of degradation	IB (15 ug/mL)		PA (3 ug/mL)	
	% Recovery	% Degradation	% Recovery	% Degradation
Undegraded	100.02	0.000	100.02	0.000
Acid	98.459	1.541	98.459	1.541
Base	94.372	5.628	94.372	5.628
Oxidative	95.179	4.821	95.179	4.821
Photolytic	98.114	1.886	98.114	1.886
Thermal	98.882	1.118	0.882	1.118

IB: Lbuprofen, PA: Paracetamol

Table 6: Regression statistics of the proposed method

Drug	R^2	Standard error	Standard error estimate	Intercept	Slope	LLOD (µg/ml)	LLOQ (µg/ml)
IB	0.9987	0.0227	0.0272	104125×	755.8	0.0133	0.0420
PA	0.9989	0.0494	0.0404	1550170×	620.2	0.0213	0.0521

LLOQ: Limit of quantitation, LLOD: Limit of detection, IB: Lbuprofen, PA: Paracetamol

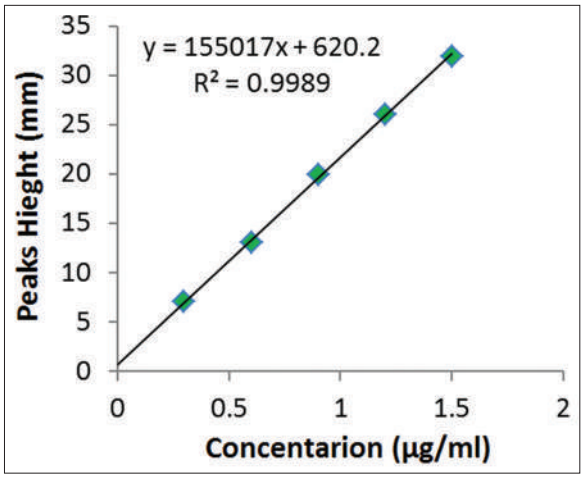


Figure 12: Linearity of the calibration curve for paracetamol

The precision[39]

The precision was established by analyzing IB at a concentration of 15 µg/ml and 3 µg/ml for PA. Two drugs (Razifen-tablets® and Rameda Pharma Limited Tenth®) were used to application analyzed IB and PA in pharmaceuticals. The system precision was tested by applying the developed method for the determination of IB and PA in the pure standard for 5 successive times (n = 5); after that, the application was used in the analyzes pharmaceutical. The method precision was tested by repeated analysis of IB and PA in tablet sample for 5 successive times (n = 5). The %RSD values for system precision and method precision were ≤0.5% for IB and ≤4 for PA, indicating that the proposed method has good precision in the analysis of mixture IB and PA in pharmaceuticals. The results are summarized in Table 8a and b.

Table 7: Summarized results of accuracy

Parameters	IB standard	PA standard	IB in Razifen drug	PA in Razifen drug	IB in Megafen drug	PA in Megafen drug
Claimed Concentration (µg mL^{-1})	15	3	15	3	15	3
Found Concentration (µg mL^{-1})	15	3	14.7	2.8	14.5	2.9
Recovery±RSD	100±0.458	100±0.300	98±0.49.8	93.3±0.311	96.6±0.441	96.6±0.299

IB: Lbuprofen, PA: Paracetamol, RSD: Relative standard deviation

Table 8a: Result of precision studies for IB

Claimed concentration (µg/ml)	Interday		Intraday	
	Found (µg/ml)	±Recovery % RSD	Found (µg/ml)	Recovery±RSD%
5	5	100±0.478	5	100±0.433
10	10	100±0.417	10	100±0.400
15	15	100±0.458	14.75	98.3±0.499
20	19.98	99.9±0.498	19	95.0±0.420
25	24.9	99.6±0.459	24.07	96.28±0.487
15.0 µg/ml Drug (Razifen-tablets®)	14.7	98±0.498	14.5	96.6±0.438
15.0 µg/ml drug (Rameda Pharma (Limited Tenth®)	14.5	96.6±0.441	14.3	95.3±0.422

IB: Lbuprofen, RSD: Relative standard deviation

Table 8b: Results of precision studies for PA

Claimed concentration (µg/ml)	Interday		Intraday	
	Found (µg/ml)	±Recovery % RSD	Found (µg/ml)	Recovery±RSD%
1	1	100±0.315	1	100±0.333
2	2	100±0.307	1.9	110±0.300
3	3	100±0.300	2.75	91.6±0.399
4	3.98	99.5±0.370	4	100±0.320
5	4.9	98.0±0.387	4.87	97.4±0.387
3.0 µg/ml drug (Razifen-tablets®)	2.8	93.3±0.311	2.9	96.6±0.338
3.0 µg/ml drug (Rameda Pharma (Limited Tenth®)	2.9	96.6±0.299	2.9	96.6±0.360

PA: Paracetamol, RSD: Relative standard deviation

Table 9: Assay of IB and PA in commercial tablets

Analyte	Labeled claim (mg)	Found (mg)	Mean (mg)	%Recovery	%RSD
IB in Razifen	200	200	400	98.0	±0.498
PA in Razifen	500	~490	990	98.0	±0.311
IB in Rameda Pharma	200	~190	390	96.6	±0.441
PA in rameda Pharma	325	~300	625	93.3	±0.299

IB: Lbuprofen, PA: Paracetamol, RSD: Relative standard deviation

THE APPLICATIONS OF METHOD

The analytical method of IB and PA in Razifen and Rameda drugs was assessed by examining commercially available tablets (Razifen-tablets® that claiming to contain 200 mg of IB and 500 mg of PA). Table 9 summarizes the application results that indicate the values of % recovery and RSD%. The proposed method was accurate and precise in IB and PA analysis in dosages forms.

CONCLUSION

This work described HPLC System (LC100 Angstrom advanced) equipped with a UV detector for IB and PA determination in two commercial pharmaceutical drugs. This developed method is considered simple and inexpensive and needs a very small volume of samples as well the ultraviolet detector makes this system very specific because it gives one peak to the IB or the PA and two peaks for both. In this application, there is a need for high sensitivity since the pharmaceutical drugs have a very low concentration. The method was validated as per the HPLC-UV guidelines and the developed method obeys Beer's law over the concentration range of 5.0–25.0 µg/mL for IB and 1–5 µg/mL for PA.

Based on the results, this study divulges with important analytical method used to determine the presence of IB and PA in the dosage forms. The stability and reliability of the results indicate that the HPLC-UV method for drug evaluation is simple, precise, accurate, sensitive, limited, and robust. The proposed method for the routine analysis of drugs can, therefore, be applied to different drug forms.

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AUTHOR'S CONTRIBUTIONS

This research was done individually in the laboratories of the College of Pharmacy, University of Basrah. This research was completed over a period of 3 months with serious and continuous work, and therefore, excellent results were obtained in finding an easy and sensitive method to estimate of simultaneous determination of IB and PA in pharmaceutical formulations.

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