Simple spectrophotometric methods for estimation of aceclofenac from bulk and formulations

Abstract

Two simple, precise and accurate visible spectrophotometric methods were developed for the estimation of Aceclofenac in bulk drug and in pharmaceutical formulations. The proposed methods were indirect and based on determination of aceclofenac after its reaction with either (p-dimethylaminocinnamaldehyde or 3-Methyl-2-benzothiazolinone hydrazine hydrochloride and measuring the chromogen at the λmax by 658 and 592, respectively. Beers law obeyed in the concentration range of 1-200 μg/ml for method A and 1-100 μg/ml for method B. The accuracy of the methods was determined by recovery studies. The methods showed good reproducibility and recovery with relative standard deviation (in %) less than 2. The methods were found to be simple, economical, accurate and reproducible and can be used for routine analysis of Aceclofenac in bulk drug and in pharmaceutical formulations.

Key words: Aceclofenac, UV Visible spectroscopy, colorimetry and validation

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INTRODUCTION

Aceclofenac is a non-steroidal anti-inflammatory drug with good analgesic and anti-rheumatic properties.[1] Chemically it is [[[2-[(2, 6-Dichlorophenyl) amino] phenyl] acetyl] oxy] acetic acid. It is used in various pain conditions like rheumatoid arthritis, osteoarthritis and ankylosing spondylatis.[1-4] Several analytical techniques like titrimetric,[4-,5] colourimetric,[6] spectroflurimetric,[6] densitometric,[7,8] HPLC,[8-10] RP–HPLC,[11,12] spectrophotometric[13,14] and stripping voltametric[15] have been reported for assay of Aceclofenac. However, some of these methods are costlier and time consuming. To overcome these difficulties, spectrophotometric analysis serves to be the quickest, promising and reliable method for routine analytical needs. The aim of the present study is to develop some rapid, reliable and precise, accurate and economical methods for the estimation of aceclofenac in bulk and in formulation by simple colorimetry using two related dye p-dimethylaminocinnamaldehyde and 3-Methyl-2-benzothiazolinone hydrazine hydrochloride.

MATERIALS AND METHODS

Apparatus

Shimadzu UV-1700 UV-Visible Spectrophotometer with 1 cm matched quartz cells was used for spectral and absorbance measurements.

Reagents and standards

All chemicals used were of analytical purity grade and all solutions were prepared in double distilled water.

p-dimethylaminocinnamaldehyde (PDAC) – A 0.25% (w/v) solution of PDAC (99%, Himedia Laboratories PVT Ltd, Mumbai, India) was prepared in methanol and used in method A.

3-Methyl-2-benzothiazolinone hydrazine hydrochloride (MBTH) – A 0.2% (*w/v*) solution of MBTH (99%, Himedia Laboratories PVT Ltd, Mumbai, India) was prepared in water.

Standard solution of aceclofenac – Pharmaceutical grade aceclofenac was procured from Mepro Pharmaceuticals, Ahmedabad, India. It was reported to be 99.97% pure and was used as received. A stock solution of aceclofenac was prepared in methanol (1 mg/ml) and was kept in refrigerator till use.

Procedures

Method A – Different aliquots (0.2 ml to 1 ml) of stock aceclofenac solution were transferred into a series of 10 ml volumetric flasks. To each flask, 3 ml of PDAC (0.25% w/v) and 1 ml of perchloric acid (1%, *w/v*) were added, heated at 90°C for 10 min with occasional shaking and cooled. The volume was then made up with methanol and absorbance of each solution was measured at 658 nm.

Method B – Varying aliquots (0.2 ml to 1 ml) of stock aceclofenac solution were transferred into a series of 10 ml volumetric flasks. To each flask, 2 ml of MBTH (0.25%, *w/v*) and 1 ml of ferric chloride (0.1%, *w/v*) were added and allowed to stand for 20 min under occasional shaking. The volume was then made up with water and absorbance of each solution was measured at 592 nm.

A standard graph was plotted for both methods and the unknown concentration was read from the graph or computed from the regression equation derived using Beer's law data.

Procedure for tablets

The formulation (Zerodol IPCA Pharma) containing 100 mg of aceclofenac tablet was analysed. In this procedure, 20 tablets were accurately weighed and powdered. The powder equivalent to 100 mg of aceclofenac was transferred to 100 ml volumetric flask and 50 ml of methanol is added to it. This mixture was sonicated in bath sonicator for 45 minutes and the volume is made up to 100 ml with methanol. It was then filtered through Whatmann filter paper. Then 5 ml of the filtrate was transferred in a 50 ml volumetric flask and the volume was made up to the mark to give a resultant concentration of 100 μg/ml. Appropriate volumes of this solution were taken according to the procedures described earlier for methods A and B.

Validation of the methods

Various concentrations of aceclofenac were tested to fix the linearity range of the methods; 1-200 μg/ml for method A and 1-100 μg/ml for method B were selected based on the correlation coefficient values [Table 1]. The limit of detection (*LOD*) and limit of quantification (*LOQ*) were calculated according to the current ICH guidelines.[16] *LOD* and *LOQ* were calculated as 3.3 and 10 standard deviation of the blank (n = 3), respectively, divided by the slope of the calibration line. The optical characteristics such as correlation co-efficient, slope, intercept, molar absorptivity, sandel's sensitivity were calculated. [The optical characteristics such as Beer's law limits and molar absorptivity values, together with other analytical performance characteristics such as *LOD*, *LOQ*, regression equation parameters are given in Table 1]. Moreover, two commercial formulations of aceclofenac tablets were successfully analyzed by the proposed methods and the values obtained by the proposed methods are given in Table 2.

The accuracy of methods was evaluated by recovery studies.[16] A known amount of standard drug material was added with pre-analyzed formulation in different levels. The amount of drug recovered was calculated and the percentage recovery was determined [Table 3].

Table 1: Optical characteristics of aceclofenac

Parameters	Method A (PDAC method)	Method B (MBTH method)
λmax (nm)	658	592
Beer's law limit (μg/ml)	1-200	1-100
Molar absorptivity (mol/l/cm)	3949	4370
Regression equation (Y=a+bx)	y = 0.011x + 0.0135	y = 0.012x + 0.018
Slope (b)	0.011	0.012
Intercept (a)	0.0135	0.018
Correlation coefficient (r)	0.9986	0.999
RSD (%) (n = 3)	0.659	0.558
Sandell's sensitivity (μg/cm2/0.001AU)	0.089	0.081
LOD (μg/ml)	0.9	0.6875
LOQ (μg/ml)	2.727	2.097

(Y = a + bx, where, x is concentration in μg/ml and Y is absorption units, a and b are intercept and slope, respectively)

Table 2: Assay of commercial formulation

Method	Label amount (mg/tablet)	Amount found* (mg/tablet)	Label Claim (%)*	RSD (%)
A	100	99.439 ± 0.655	99.439	0.659
B	100	99.342 ± 0.505	99.342	0.508

* Mean ± SD of three observations

Table 3: Intraday and interday precision of the method

Method	Amount found		RSD (%)	
	Intraday*	Interday*	Intraday*	Interday*
A	99.392 ± 0.681	99.385 ± 0.520	0.685	0.523
B	99.247 ± 0.474	99.251 ± 0.603	0.477	0.608

* Mean ± SD of six observations

Table 4: Recovery studies

Method	Formulation Amount present (µg/ml)	Amount of Standard added* (µg/ml)	Recovery (%)*	S.D.	RSD (%)
A	60	48	99.6504	0.2195	0.2203
	60	60	99.2989	0.2299	0.2315
	60	72	99.6392	0.2926	0.2937
B	50	40	98.9106	0.2672	0.2701
	50	50	99.4521	0.3143	0.316
	50	60	99.3912	0.2461	0.2461

* Mean ± SD of three observations

The evaluation of robustness was performed by evaluating the inter-day and intra-day precision of the methods. For this purpose, the analysis of formulation was carried out for three times in the same day and on three successive days [Table 4].

RESULTS AND DISCUSSION

Method development

The proposed spectrophotometric methods are indirect and are based on determination of aceclofenac after its reaction with either PDAC or MBTH and measuring the chromogen at the respective λ_{max}. Preliminary experiments were conducted to determine the optimum concentration and volumes of PDAC and MBTH to give the highest response.

A volume of 3 ml of PDAC (0.25% w/v) and 1 ml of perchloric acid (1%, *w*/*v*) for method A and 2 ml of MBTH (0.25%, *w*/*v*) and 1 ml of ferric chloride (0.1%, *w*/*v*) for method B were fixed. The optimum time required for the reaction completion in two methods was studied and was discovered that the reaction of aceclofenac with PDAC requires 10 min and aceclofenac that of with MBTH requires 20 min. The chromogen formed by both methods was stable for not less than 2 hours. The correlation co-efficient was found to be 0.9986 for method A and 0.999 for method B, respectively. To study the precision of the method, the analysis of formulation was carried out for three times. The RSD (%) values were found to be 0.659 for method A and 0.558 for method B. Hence, the precision of the methods were confirmed. Further, the precision was confirmed by intermediate precision. The analysis of formulation was carried out for three times in the same day and on three successive days. The RSD (%) value for interday and intraday analysis of formulation was found to be less than 2% and is shown in Table 3. The accuracy of method was confirmed by recovery studies [Table 4]. A known amount of standard drug material was added with pre--analyzed formulation in different levels. The amount of drug recovered was calculated and the average percentage recovery was found to be in the range of 99.2989–-99.63926% for method A and 98.9106–99.4521% for method B. The low RSD (%) values ensured the accuracy of the method.

CONCLUSIONS

Two rapid, sensitive and accurate colorimetric methods for the determination of aceclofenac have been developed and validated. They are rapid, do not involve complicated extraction procedures and consume less time. The current spectrophotometric methods use cheap chemicals and inexpensive equipment while providing good sensitivity comparable even to the HPLC. This makes these methods highly suitable for quick routine analysis of aceclofenac in pharmaceutical dosage forms.

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