Innovare Academic Sciences

International Journal of Pharmacy and Pharmaceutical Sciences

ISSN- 0975-1491 Vol 6, Issue 6, 2014

Original Article

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF COLCHICINE IN PHARMACEUTICAL FORMULATIONS AND BIOLOGICAL FLUIDS

BABU GIRIYA GOWDA*

Department of Chemistry, Maharani's Science College for Women, Bangalore 560001, India.
Email: babgowda@gmail.com

Received: 24 Apr 2014 Revised and Accepted: 23 May 2014

ABSTRACT

Objective: A simple, rapid, precise and accurate high performance liquid chromatography (HPLC) method has been developed for the estimation of colchicine (COLC) in bulk drug, pharmaceutical formulations and biological fluids.

Methods: The developed HPLC method involves the using of a mixture of acetonitrile : methanol : water (32:48:20 v/v) as a mobile phase. The pH of the mobile phase was adjusted to 5.2 with phosphoric acid. A CLC C_{18} column (5 µm, 25 cm x 4.6 mm i.d.) was used for the elution. The flow rate of the mobile phase was set to 1.2 ml/min. Injection volume was set at 20 µl and the detection of the analyte was done at 254 nm.

Results: The linear regression analysis data for calibration curve showed a good relationship with correlation coefficient of 0.9997. The concentration range was 7-130 µg/ml. The percentage recovery of COLC was found to be 99.87 %. The limits of detection and quantification are also reported. This selective method is found to be accurate, precise and effectively used for the determination of COLC in various pharmaceutical formulations and biological fluids with better chromatographic conditions.

Conclusions: The method was successfully applied to the assay of COLC in pharmaceutical formulations and biological fluids and the results were statistically compared with those of the reference method by applying Student's t-test and F-test. No interference was observed from the common tablet excipients. The accuracy of the method was further ascertained by performing recovery studies via standard-addition method.

Keywords: Colchicine, RP HPLC method, Pharmaceutical formulations, Biological fluids.

INTRODUCTION

The genus Colchicum belongs to the colchicaceae family. Molecular formula of COLC $C_{22}H_{25}NO_6$ (Fig. 1) with IUPAC name N-[(7*S*)-1,2,3,10-tetramethoxy-9-oxo-5,6,7,9- tetrahydrobenzo [*a*] heptalen-7-yl] acetamide and molecular weight is 399.44 g/mol.

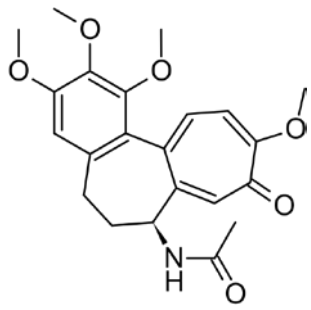

Fig. 1: Structure of Colchicin

It is a highly poisonous alkaloid containing various species of colchicum. COLC is the main alkaloid obtained from the bulb and seeds of colchicum. It is used in human and veterinary medicine. The medicinal value of colchicum is due, to the presence of (-)-colchicine, the main alkaloid, which was isolated from all species of colchicum. It is widely used in breeding studies and as drug to treat gout but is also valuable for other diseases such as familial Mediterranean fever, primary biliary cirrhosis and breast cancer [1-7]. Generic COLC is available in tablets. (-)-Colchicine, is a phenylethyl isoquinoline derived alkaloid, and it is a poisonous, lipid-soluble alkaloid with a unique 7-memberd aromatic tropolone ring [8-10]. Several analytical methods for the determination of COLC in pharmaceutical preparations, in biological fluids and in plant extracts have been described [11-14]. The aim of the present study is to develop an accurate and reliable method for the quantification of COLC in tablets using HPLC.

MATERIALS AND METHODS

Apparatus and chromatographic conditions

All HPLC measurements were made on a Shimadzu Corporation system (Analytical instruments Division, Kyoto, Japan). The system consists of an LC 10AT solvent pump, an SPD10DVP detector and a data station with Win-chrome software, version 3.1. The separation was performed on a CLC C_{18} column (5 µm, 25 cm x 4.6 mm i.d.). A CLC ODS (4 cm x 4.6 mm, i.d.) was used as a guard column to protect the analytical column. A mixture of acetonitrile : methanol: water (32:48:20 v/v; pH adjusted to 5.2 with phosphoric acid) was used as a mobile phase at a flow rate of 1.2 ml/min with an operating pressure of 131-133 kg/cm^2. A Hamilton 702 µLR injector with a 25 L loop was used for the injection of the samples. The mobile phase was filtered through 0.45 µm membrane filter and degassed by using sonicater for about 10 min before use. The sample solutions were also filtered using 0.45 µm membrane filters. Detection was performed at 254 nm with a sensitivity of 0.2 AUFS. All determinations were performed at ambient temperature. The injection volume was 20 µl and the total run time was 10 minutes.

Materials and Reagents

All chemicals used were of analytical or pharmaceutical grade. Acetonitrile (HPLC grade) and dihydrogen orthophosphate (AR grade) supplied by S.D. Fine-Chem, Ltd., India and Merck (India) Ltd., respectively were used. COLC standard was purchased from Sigma Aldrich. Dosage forms of COLC, manufactured by different firms, were obtained commercially. The body fluids which were received in forensic science laboratory for toxicological analysis were used. These body fluids were said to be collected from a body of a person who suspected to be died due to the consumption of plant material of *Gloriosa superba*.

Standard COLC solution

A stock solution of COLC was prepared by dissolving 100 mg of COLC in mobile phase in a 100 ml calibrated flask to get 1000 µg/ml. The standard solutions were prepared by further dilution of the stock

standard solution with the specified mobile phase to reach the concentration range of 7-130 µg/ml.

Recommended general procedure

Suitable amounts of aliquots of standard COLC were transferred in to a series of 5 ml calibrated flasks and diluted to the volume with acetonitrile and mixed well. Then, 20 µl of the solution was injected and a chromatogram was noted. A calibration graph was plotted.

Procedure for pharmaceutical formulations (tablets)

Twenty tablets of COLC were weighed and finely powdered and an amount equivalent to 100 mg of COLC was dissolved in mobile phase and filtered. After keeping for 5 min in an ultrasonic, the solution was diluted to volume, filtered through 0.45 µm Millipore membrane filter and degassed. A 20 µl solution was then injected into chromatographic system.

Procedure for biological fluids

Biological fluids (1 ml each) were extracted with 1 ml saturated NH_4Cl solution and adjusted to pH 9.6 with ammonia and 5 ml of dichloromethane with 5 % 2-propanol. After 10 min agitation, the tubes were centrifuged for 5 min at 3500 rpm. The organic layer was transferred into glass tubes and then evaporated to dryness at 45ºC. The residues were reconstituted in 75 µl mobile phase. An aliquot was analysed using the procedure described earlier.

RESULTS

Method development

The mobile phase was chosen after several trials with methanol, acetonitrile, water and buffer in various proportions and at different pH values. A mobile phase consisting of acetonitrile : methanol: water (32:48:20 v/v; pH adjusted to 5.2 with phosphoric acid) was selected to achieve the maximum separation and sensitivity. Flow rates between 0.5 and 2.0 ml/min were tried. It was observed that a flow rate of 1.2 ml/min gave an optimal signal-to-noise ratio with a reasonable separation time.

Using a reverse-phase C_{18} column, the retention time for COLC was observed to be 8.767 min. A total time of 10 min was necessary for the analysis. COLC exhibited absorption maxima at 254 nm. Under optimum conditions, the chromatograms of a series of COLC standard solutions were recorded. A computer controlled data station with Win-chrome software was used to plot the peak area versus the concentration in µg/ml.

Analytical features

To set up a linearity range, a series of COLC solutions of different concentrations were prepared in mobile phase in the range of 7-130 µg/ml. The reproducibility of the detector response at each concentration level was examined by carrying out the experiment in triplicate. A typical chromatogram is shown in Fig. 2.

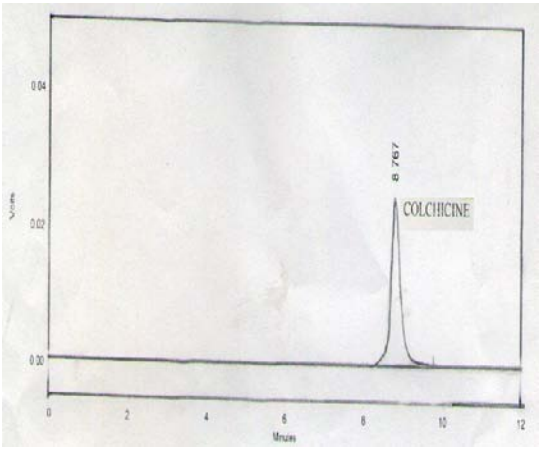

Fig. 2: HPLC Chromatogram of Colchicin standard (5µg/ml)

A calibration curve was obtained by plotting the peak area of the standard to the COLC concentration. Further, COLC showed linearity in the concentration range of 5-130 µg/ml. A good correlation between COLC peak areas and drug concentration was observed with $r^2 \geq 0.9998$. The minimum detectable and quantifiable concentration of COLC under the optimised conditions was found to be 2 µg/ml and 5 µg/ml respectively. Precision of the method was studied with 5 replicates of the standard solution. The results are shown in **Table 1** and **2.** The low values of the relative standard deviation indicate the high precision of the method.

Table 1: *Rt*, linear regression, LOD and LOQ for COLC

Standard	*Rt Min*	Regression equation	r[a]	% SD	LOD (µg/ml)	LOQ (µg/ml)
Colchicine	8.76	Y = 1938.887 + 13.948*X	0.9998	2.65	2	5

a Correlation coefficient

Table 2: Analysis of pharmaceutical preparations of COLC

Formulation	Label claim mg/tablet	Recovery** ± SD %	
		Reported method [15]	Proposed method
Goutnil (Tablet)	0.5	100.18 ± 0.15	99.2 ± 0.88, F=1.73; t=0.85
Colchicindon (Tablet)	0.5	100.04 ± 0.13	101.1 ± 0.92, F=1.50; t=0.87

***Recovery value by the proposed method is the mean of five determinations. The calculated F- and t- values refer to 95 % confidence limits.*

Recovery studies

To study the accuracy and reproducibility of the proposed method, recovery experiments were carried out. The recovery of the added standard was studied at five different concentration levels. Each level was repeated five times. To an aliquot of the analysed preparations, a known concentration of the standard solution was added. The COLC contents were once again determined by the proposed method. From the amount of the drug present, the percent recovery was calculated using the following formula:

Where, x is the amount of standard drug added, y is the amount of drug found by proposed method, and N is the number of observations. The results obtained are shown in Table 3.

$$\% \text{ Recovery} = \frac{N(\sum xy) - (\sum y)(\sum x)}{N(\sum x^2)(\sum x)^2}$$

The results of the analysis of peripheral blood, cardiac blood and urine samples were shown in Table 4.

The results obtained are compared with those obtained by the reported method [16]. It was also observed that the COLC peripheral blood concentration observed in the proposed method (25.4 ng/ml) was much higher than therapeutic concentration range (0.3 to 2.4 ng/ml) [16].

Table 3: COLC recovery investigations

Compound	Amount of standard added (µg/ml)	Amount of standard detected (µg/ml)	Recovery*%	RSD%
Colchicine	100	103.35 ± 2.92	103.35	2.82
	250	252.61 ± 6.08	101.04	2.40
	500	497.20 ± 4.28	99.44	0.86

* Recovery value by the proposed method is the mean of five determinations.

Table 4: Analysis of biological fluids

Biological fluids	Concentrations ng/ml	
	Reported method [16]	Proposed method
Peripheral Blood	21.9	25.8
Cardiac Blood	22.8	28.5
Urine	148.5	152.5

CONCLUSION

The proposed method gives a good accuracy and reproducibility. The total time of analysis was only 10 min. The method is simple, rapid and does not involve complicated sample preparation. High percent recovery values show that the method was free from interference by the excipients used in the preparations. Hence, the present method could be used for routine quality control as well as to analyse biological fluids.

ACKNOWLEDGEMENTS

The author sincerely thanks the director, university instrumentation centre, Karnataka University, Dharwad for providing necessary instrumental facilities. Thanks are also due to the Deputy Director, Regional Forensic Science Laboratory, Mangalore for providing biological fluids.

REFERENCES

1. Niel E, Scherrmann J-M. Colchicine today. Joint, bone, spine : revue du rhumatisme 2006;73(6):672-8.
2. Kaplan MM, Alling DW, Zimmerman HJ, Wolfe HJ, Sepersky RA, Hirsch GS, et al. A prospective trial of colchicine for primary biliary cirrhosis. The New England journal of medicine 1986;315(23):1448-54.
3. Gabrscek L, Lesnicar G, Krivec B, Voga G, Sibanc B, Blatnik J, et al. Accidental poisoning with autumn crocus. Journal of toxicology. Clinical toxicology 2004;42(1):85-8.
4. Sannohe S, Makino Y, Kita T, Kuroda N, Shinozuka T. Colchicine poisoning resulting from accidental ingestion of meadow saffron (Colchicum autumnale). Journal of forensic sciences 2002;47(6):1391-6.
5. Terkeltaub RA. Clinical practice. Gout. The New England journal of medicine 2003;349(17):1647-55.
6. Drenth JP, van der Meer JW. Hereditary periodic fever. The New England journal of medicine 2001;345(24):1748-57.
7. Sakane T, Takeno M. Novel approaches to Behçet's disease. Expert opinion on investigational drugs 2000;9(9):1993-2005.
8. Dollery C, Boobis A, Rawlings M, Thomas S, Wilkings M. Therapeutic drugs1999. 320-2 p.
9. Trease GE, Evas WC. Trease and Evans'Pharmacognosy, 13th ed1989. 600-3.
10. Herbert RB, Knagg E. The biosynthesis of the phenethyl isoquinoline alkaloid, colchicine, from cinnamaldehyde and dihydrocinnamaldehyde. Tetrahedron Lett 1986;27(9):1099-102.
11. Sutlupinar N, Husek A, Potesilova H, Dvorackova S, Hanus V, Sedmera P, et al. Alkaloids and Phenolics of Colchicum cilicicum Planta Med. Expert opinion on investigational drugs 1988;54(3):243-5.
12. Poulev A, Deus-Neumann B, Bombardelli E, Zenk MH. Immunoassays for the quantitative determination of colchicine. Planta medica 1994;60(1):77-83.
13. Ondra P, Valka I, Vicar J, Sutlupinar N, Simanek V, J. Chromatographic determination of constituents of the genus Colchicum. Expert opinion on investigational drugs 1995;704(2):351-6.
14. Al-Fayyad M, Alali F, Alkofahi A, Tell A. Determination of colchicine content in Colchicum hierosolymitanum and Colchicum tunicatum under cultivation. Natural product letters 2002;16(6):395-400.
15. Narayana B, Divya NS, A. method for Spectrophotometric determination of colchicoside. Journal of Scientific and Industrial Research 2010;69:368-72.
16. Marc C. Marjorie and Gilbert Pepin: Liquid Chromatography-Tandem Mass Spectrometry for the Determination of Colchicine in Post Mortem Body Fluids. Case report of two fatalities and Review of the Literature 2006;30:593-8.