Journal of Pharmaceutical & Biomedical Analysis
Vol. 9, No. 2, pp. 97–100, 1991
Printed in Great Britain

0731–7085/91 $3.00 + 0.00
Pergamon Press plc

Spectrophotometric determination of diclofenac sodium in tablets

Y.K. AGRAWAL*† and K. SHIVRAMCHANDRA‡

†*Pharmacy Department, M.S. University, Kalabhavan, Baroda, India*
‡*M.J. Institute of Research, Baroda, India*

Abstract: Simple spectrophotometric methods are described for the determination of diclofenac. In the first method diclofenac reduces iron(III) to iron(II) when heated in aqueous solution. The ferrous ions produced react with 2,2'-bipyridine to form a complex having a maximum absorbance at 520 nm. The reaction obeys Beer's Law for concentrations of 10–80 μg ml^{-1}. This method can be applied to the determination of diclofenac in tablets. In the second method, diclofenac is treated with Methylene Blue in the presence of phosphate buffer (pH 6.8) and the complex is extracted with chloroform. The complex has a maximum absorbance at 640 nm and the graph of absorbance against concentration is linear in the range 5–40 μg ml^{-1}. This method can be applied to the determination of diclofenac in tablets that also contain paracetamol.

Keywords: *Diclofenac sodium; colorimetry; spectrophotometry; tablets.*

Introduction

Diclofenac sodium is the sodium salt of [*o*-(2,6-dichloroanilino)phenyl] acetic acid and is a well known analgesic and anti-inflammatory agent. Visible spectrophotometric [1–5], GLC [6–8] and HPLC [9–11] methods for its determination have been described.

The present work describes colorimetric methods for the determination of diclofenac sodium in tablets.

Experimental

Instrumentation

All spectral and absorbance measurements were made on a Shimadzu (UV 260) UV–vis spectrophotometer with 10-mm matched glass cells.

Chemicals

All chemicals used were of AR grade. Diclofenac sodium reference standard was obtained from Quantum Chemicals Co. Ltd (Taiwan).

Ferric chloride solution. A 0.2% (w/v) solution was prepared in alcohol.

2,2'-Bipyridine solution. A 0.5% (w/v) solution was prepared in alcohol.

Mixed phosphate buffer (pH 6.8; 0.1 M). To 500 ml of 0.1 M potassium dihydrogen orthophosphate, a sufficient quantity of 0.2 M disodium orthophosphate was added to adjust the pH to 6.8 and the solution was diluted to 1000 ml with distilled water.

Methylene Blue solution. 25 mg of Methylene Blue was dissolved in 100 ml of 0.1 M phosphate buffer (pH 6.8). The solution was extracted with 30 ml of chloroform in a separating funnel to remove chloroform-soluble impurities. The aqueous layer was filtered through Whatman No. 1 filter-paper.

Standard stock solution. 50 mg of diclofenac sodium was dissolved in 50 ml of distilled water.

Procedure for the calibration curve

Method I (using ferric chloride and 2,2'-bipyridine). 10 ml of standard stock solution was further diluted to 50 ml with water. Aliquots of diclofenac sodium solution (200 μg ml^{-1}; 1–5 ml) were placed into a series of 10-ml volumetric flasks. To each flask were added 1 ml ferric chloride solution and 1 ml of 2,2'-bipyridine solution; each solution was diluted to 10 ml with distilled water. The flasks were stoppered and kept in a boiling water-bath for 25 min. The solutions were cooled to room temperature and the absorbance was measured at 520 nm against a reagent blank.

The graph of absorbance against concentration was linear in the range 10–80 μg ml^{-1}.

*Author to whom correspondence should be addressed.

The intercept was 0.0844 and the correlation coefficient was 0.9952.

Method II (using Methylene Blue). 10 ml of standard stock solution was diluted to 100 ml with phosphate buffer (pH 6.8). Aliquots of diclofenac sodium solution (100 μg ml^{-1}; 2, 4, 6, 8 and 10 ml) were placed in 100-ml separating funnels. The volume of each solution was adjusted to 10 ml with buffer solution (pH 6.8). To each solution 5 ml of Methylene Blue solution was added and the complex was extracted with 10-, 10- and 5-ml portions of chloroform. The solution was shaken for 1 min each time and the chloroform layer was passed through a layer of anhydrous sodium sulphate (≈500 mg) into a 25-ml volumetric flask. The volume of the chloroform layer was made up to 25 ml and the absorbance was measured at 640 nm against a reagent blank. Linearity in the graph of absorbance against concentration was observed in the range 5–40 μg ml^{-1}; the intercept was 0.4715 and the correlation coefficient was 0.9976.

Results and Discussion

Standardization of analytical parameters

Method I.

Volume of ferric chloride solution. To a fixed quantity of drug solution (5 ml; 25 μg ml^{-1}) different volumes (0.5–3 ml) of ferric chloride solution were added. The colour was developed as described under the procedure for the calibration curve. It was found that an optimum volume of 1 ml of ferric chloride solution was required for maximum colour development.

Volume of 2,2'-bipyridine solution. To a fixed quantity of drug solution (5 ml; 25 μg ml^{-1}) different volumes (0.5–2 ml) of 2,2'-bipyridine solution were added and the colour was developed as described earlier. It was observed that an optimum volume of 1 ml of 2,2'-bipyridine solution was required for colour development.

Heating time. 5 ml of diclofenac sodium solution (25 μg ml^{-1}) was placed in each of five 10-ml volumetric flasks. 1 ml of ferric chloride solution and 1 ml of 2,2'-bipyridine solution were added to each flask and the solution was diluted to 10 ml with distilled water. The solutions were kept in a boiling water-bath for different time intervals (10, 20, 25, 30 and 40 min). It was observed that the optimum heating time was about 25 min for maximum colour development.

Method II.

Dye concentration. To a fixed quantity of drug solution (5 ml; 100 μg ml^{-1}) different volumes (1–7 ml) of dye solution were added in separating funnels. The volume of the total aqueous layer was adjusted to 15 ml with buffer solution. The complex was extracted with chloroform and the absorbance was measured. An optimum volume of 5 ml of dye solution was required for maximum colour development.

pH of the buffer. 10 ml of standard stock solution was diluted to 100 ml with distilled water. 5 ml of diclofenac solution was placed in each of a series of separating funnels. 10 ml of 0.1 M phosphate buffer of different pH (5.5, 6, 6.5, 7, 7.5 and 8) was added and the colour of the chloroform extract was measured against reagent blank. The maximum colour was found at pH 6.6–7.0. After a study of the linearity of the graph of absorbance against concentration the pH was fixed at 6.8. The concentration of buffer was fixed at 0.1 M after several experiments.

Volume ratio. After several sets of extraction experiments it was found that the extraction was quantitative when the ratio (v/v) of aqueous solution to chloroform was 1.5:1. Further extraction of 15 ml of aqueous layer was done with 10-, 10- and 5-ml portions of chloroform.

Tablet analysis

Method I. An accurately weighed quantity of powdered tablets equivalent to 50 mg of diclofenac sodium was placed in a 50-ml volumetric flask. 30 ml of distilled water was added and the solution was shaken for 5 min to dissolve the drug. The volume was made up to 50 ml and the solution was filtered. 5 ml of the filtrate was further diluted to 200 ml with distilled water.

A standard solution containing 25 μg ml^{-1} of drug was prepared in distilled water.

Five millilitres of the standard and sample solutions were placed in 10-ml volumetric flasks. 5 ml water was used as the reagent blank. To each flask 1 ml of ferric chloride solution and 1 ml of 2,2'-bipyridine solution

Table 1
Analysis of tablets of diclofenac sodium

Formulation	Labelled amount of diclofenac sodium (mg)	Found			
		Method I		Method II	
		Amount (μg)	Recovery (%)	Amount (μg)	Recovery (%)
Tablet A	50	49.73	99.46	49.65	99.30
Tablet B	50	50.32	100.64	50.18	100.36
Tablet C	50	48.77	97.54	48.85	97.70
Tablet D	50, with paracetamol 500	—	—	49.12	98.24
Tablet E	50, with paracetamol 325	—	—	49.31	98.62

were added. The flasks were stoppered and kept in a boiling water-bath. After 25 min the flasks were cooled to room temperature and the volumes were made up to 10 ml with distilled water. The absorbance of the solutions was measured at 520 nm against a reagent blank. The results are shown in Table 1.

Method II. A quantity of powdered tablets equivalent to 50 mg of diclofenac sodium was shaken with 30 ml of water in a 50-ml volumetric flask. The volume was made up to 50 ml and filtered. 5 ml of filtrate was further diluted to 100 ml with phosphate buffer (pH 6.8).

A working standard of diclofenac sodium containing 50 μg ml^{-1} was prepared in phosphate buffer (pH 6.8).

Ten-millilitre portions of standard and sample solutions were placed in separating funnels. 5 ml of Methylene Blue solution was added to each solution. The colour was extracted wtih 10-, 10- and 5-ml portions of chloroform. The chloroform extracts were passed through a layer of anhydrous sodium sulphate and collected in 25-ml flasks. The volume was made up to 25 ml with chloroform and the absorbance was measured at 640 nm against a reagent blank. The results are shown in Table 1.

Reproducibility and Recovery

Method I

Five millilitres of diclofenac sodium solutions (25 μg ml^{-1}) was placed in each of six 10-ml flasks. The colour was developed as described under procedure for the calibration curve. The absorbance values were found to be reproducible with a relative standard deviation (RSD) of 0.47%.

For recovery studies 3 ml of standard diclofenac sodium solution was added to 3 ml of tablet solution which had been analysed earlier. The colour of this solution was developed together with that of 6 ml of standard diclofenac sodium solution. The recovery of drug was 98.92–101.03%.

Method II

The reproducibility of the method was satisfactory with a RSD of 0.63% (n = 6).

For recovery studies, 5 ml of standard diclofenac sodium solution (50 μg ml^{-1}) was added to 5 ml of tablet solution which had been analysed earlier. The recovery of drug was 98.20–102.94%.

The methods described are simple and sensitive. Common excipients found in tablet preparations will not interfere with the methods. Interference was observed in the presence of oxidizing agents but these can be removed by a suitable extraction procedure. The method using ferric chloride and 2,2′-bipyridine is not suitable for the determination of diclofenac in the presence of paracetamol since ferric chloride will react with paracetamol. The method using Methylene Blue can be applied to the analysis of diclofenac in tablets, including those that also contain paracetamol.

References

[1] Mingxin He and Yanxin Yang, *Yaowu Fenxi Zazhi* **7**, 54–56 (1987).
[2] C.S. Sastry, A.R.M. Rao and T.N.V. Prarasad, *Anal. Lett.* **20**, 349–359 (1987).
[3] R.T. Sane, R.S. Samanth and V.G. Nayak, *Indian Drugs* **24**, 161–162 (1986).
[4] C.S.P. Sastry and A.R.M. Rao, *J. Pharm. Meth.* **19**, 117–125 (1988).
[5] Y.K. Agrawal, V.P. Upadhyay and S.K. Menon, *Indian J. Pharm. Sci.* **50**, 58 (1988).
[6] W. Schneider and P.H. Degen, *J. Chromatogr.* **217**, 263 (1981).
[7] U.P. Geiger, P.H. Degen and A. Sioufi, *J. Chromatogr.* **111**, 293 (1975).
[8] M.E. Sharp, *J. Anal. Toxicol.* **11**, 8–11 (1987).

[9] R.T. Sane, R.S. Samant and V.G. Nayak, *Drug Dev. Ind. Pharm.* **13**, 1307–1314 (1987).
[10] S.G. Owen, M.S. Roberts and W.T. Friesen, *J. Chromatogr.* **416**, 293–302 (1987).
[11] C. Girchetti, P. Poletti and G. Zando, *J. High Resolut. Chromatogr., Chromatogr. Commun.* **10**, 469–471 (1987).

[*Received for review 18 January 1990*]