

# Studies on Drug Releases of Anti-Inflammatory Tablets Containing Diclofenac Sodium

Pooja Vishwakarma<sup>1</sup> P.K. Sharma<sup>2</sup> R.N. Shukla<sup>3</sup>

<sup>1</sup>Student <sup>2</sup>Associate professor Professor & HOD<sup>3</sup>

<sup>1,2,3</sup>Department of Applied Chemistry

<sup>1,2,3</sup>Samrat Ashok Technological Institute Vidisha (M.P.) 464001 [India]

**Abstract**— Oral release of drugs is the most preferable way of drug delivery due to the easiness of administration, patient compliance and flexibility in formulation. Where immediate release dosages may be broken down in gastric environment and affect the parts of gastric system. For avoid gastric troubles modified-release tablets include delayed release (eg. Enteric coated) and extended release (eg. sustained release) are designed to modify the rate, the place or the time at which the active ingredient are released. The experimental intend has conducted comparative study of different brands of six modified release type of marketed diclofenac sodium tablets in which Sustained release, enteric coating was taken. The study was completed by conducting different quality control parameters like identification, uniformity of weight variation, percentage assay, disintegration and dissolution on sustained release and enteric coated form of diclofenac sodium. All the tablets compared with authorized standard were found within the range. Dissolution studies showed that diclofenac sodium was slowly released in all samples of sustained release tablets compared to that of enteric coated tablets.

**Key words:** Diclofenac Sodium, modified release, sustained release, enteric coating, and drug release

## I. INTRODUCTION

Anti-inflammatory refers to the property of a substance or treatment that reduces inflammation or swelling. Two main groups of anti-inflammatory drugs are Steroidal anti-inflammatory drugs block the action of phospholipase and Non-steroidal anti-inflammatory drugs block the action of cyclo-oxygenase.<sup>[1]</sup> Non-steroidal anti-inflammatory drugs shows, analgesic, antipyretic, and anti-inflammatory effects. Part of the popularity of NSAIDS is that unlike opioids, they do not produce sedation or respiratory depression.<sup>[2]</sup> Non-steroidal anti-inflammatory drugs (NSAIDs) have been the keystone of ache management in patients with osteoarthritis conditions, Rheumatoid Arthritis, Ankylosing Spondylitis, Psoriatic Arthritis, Gout and other aching situation.<sup>[3]</sup> For to resolve these major problems many anti-inflammatory drugs have been produced such as Fenoprofen, Flurbiprofen, Ibuprofen, Indomethacin, Diclofenac, Naproxen etc. Diclofenac sodium is one of them. Diclofenac sodium well absorbed orally, 99% protein binding, drugs have analgesic action at low dose and anti-inflammatory action at high dose. Its pharmacological effects are due to blocking the conversion of arachidonic acid to prostaglandins by inhibiting cyclo-oxygenase enzymes.<sup>[4]</sup> Diclofenac is presented as tablets (enteric coated, controlled release, immediate release), creams and injectables. There are different classes of tablets such as uncoated and coated available in the market.<sup>[5]</sup>

Generally coating is applied to grant specific benefits over uncoated variety i.e. to give an esthetic touch and to control the release of the drug.<sup>[6]</sup> Some of the drugs may

be broken down in gastric environment and some may irritate parts of gastric system. A thick coating is applied around the tablet which may prevent the drug release in acidic environment.<sup>[7]</sup> Film coating is a technique extensively used in the pharmaceutical field to advance and modify technological and release characteristics due to the potential of depositing a variety of coating materials onto solid cores, Such as Hydroxy Propyl Methyl Cellulose (HPMC), Ethyl Cellulose (EC), Hydroxy Propyl Cellulose (HPC) etc. Enteric polymers have been shown to be harmless and extensively accepted for apply in drug products.<sup>[8]</sup> such as Cellulose acetate phthalate (CAP), Acrylate polymers, Polyvinyl acetate phthalate etc. which are insoluble at low pH but dissolve at a pH around or below 7.<sup>[9]</sup> Oral release of drugs is the most preferable way of drug delivery due to the easiness of administration, patient compliance and flexibility in formulation.<sup>[10]</sup> The way of drug release from modified release (MR) dosage forms is intentionally changed from that of conventional dosage formulation to attain a desired therapeutic aim or better patient compliance. Types of MR drug include delayed release (Enteric coated), extended release (sustained release), and orally disintegrating tablets (ODT).

### A. Drug Release:

Sustained release dosage form allows at least a two fold reduction in dosage frequency as compared to an immediate release dosage form. These are release a drug at a predetermined rate.<sup>[11]</sup> Enteric coated dosage form releases a discrete fraction or fraction of drug at a time other than quickly after administration.<sup>[12]</sup>

## II. MATERIALS AND METHODS

### A. Materials:

Different samples of diclofenac sodium with two different formulations i.e. film coated sustained release and enteric coated were collected. The collected samples were designated as FTS<sub>1</sub>, FTS<sub>2</sub>, FTS<sub>3</sub>, ETS<sub>1</sub>, ETS<sub>2</sub> and ETS<sub>3</sub>. The study was performed within samples expiration dates. The reagents used were methanol, conc. HNO<sub>3</sub>, 0.1N HCL, 5N NaOH, tribasic sodium phosphate, potassium dihydrogen orthophosphate and freshly distilled water.

### B. Methods:

#### 1) Identification:

The identification of each sample was performed as per the method B given in IP volume (II) 2007.<sup>[13]</sup>

#### 2) Uniformity of Weight:

The average weight of each sample was performed as per the method appendix 2.5.3 given in IP volume (II) 2007.<sup>[13]</sup>

3) Assay of diclofenac sodium:

The assay determination of diclofenac sodium was performed as per IP volume (II) 2007. [13]

4) Disintegration Test:

The disintegration test of diclofenac sodium was performed as per method given in IP volume (II) 1996. [14]

5) Dissolution studies:

Drug release of film coated sustained release and enteric coated tablets were determined as per USP 2009. [15]

III. RESULTS AND DISCUSSIONS

A. Identification:

As per IP, the identification test confirmed the presence of diclofenac sodium (API) in all samples as shown in table-1.

S. No.	SAMPLE CODE	OBSERVATION	RESULT
1	FTS <sub>1</sub>	Dark red color developed	Confirmed
2	FTS <sub>2</sub>	Dark red color developed	Confirmed
3	FTS <sub>3</sub>	Dark red color developed	Confirmed
4	ETS <sub>1</sub>	Dark red color developed	Confirmed
5	ETS <sub>2</sub>	Dark red color developed	Confirmed
6	ETS <sub>3</sub>	Dark red color developed	Confirmed

Table 1:

B. Uniformity of weight:

As per IP tablets with average wt. is less than 80mg, 80 to 249mg, more than 250mg have percentage deviation 10%, 7.5%, 5.0% respectively and uniformity of weight is not applicable for enteric coated tablets. Although the result showed that uniformity of weight test of FTS<sub>1</sub>, FTS<sub>2</sub> and FTS<sub>3</sub> was showing percentage deviation 5.0%, 7.5%, 5.0% respectively, FTS<sub>3</sub> had all (20) tablets under limit of deviation in comparison to FTS<sub>1</sub> and FTS<sub>2</sub>. Hence FTS<sub>3</sub> was found more suitable for utilization in comparison to FTS<sub>1</sub> and FTS<sub>2</sub>. Results are shown in table no 2.

S. No.	Sample code	Wt. of 20 tablets (gm)	Average weight (mg)	Percentage deviation (%)
1	FTS <sub>1</sub>	6.320	316.0	5.0
2	FTS <sub>2</sub>	3.336	166.8	7.5
3	FTS <sub>3</sub>	5.952	297.6	5.0
4	ETS <sub>1</sub>	2.678	133.9	-
5	ETS <sub>2</sub>	5.612	280.6	-
6	ETS <sub>3</sub>	4.110	205.5	-

Table 2:

C. Assay of diclofenac sodium:

As per IP percentage assay limit is 90% to 110%. Although assay of sample FTS<sub>1</sub>, FTS<sub>2</sub>, FTS<sub>3</sub>, ETS<sub>1</sub>, ETS<sub>2</sub>, ETS<sub>3</sub> were 107.96%, 90.16%, 109.30%, 99.52%, 104.24% and 101.48% respectively which was under limit and thus was found suitable for use. Whose results are shown in table 3.

S.No	SAMPL E CODE	SAMPL E TAKEN (mg)	WAVLENGT H (nm)	ABSORBANC E	ASSA Y (%)
1	FTS <sub>1</sub>	93.3	285	0.632	107.96
2	FTS <sub>2</sub>	53.5	285	0.430	90.16
3	FTS <sub>3</sub>	84.3	285	0.615	109.30
4	ETS <sub>1</sub>	70.7	285	0.521	99.52
5	ETS <sub>2</sub>	142.3	285	0.524	104.24
6	ETS <sub>3</sub>	106.0	285	0.519	101.48

Table 3:

Fig: 1-6 represents the graphical presentation of % assay analysis.

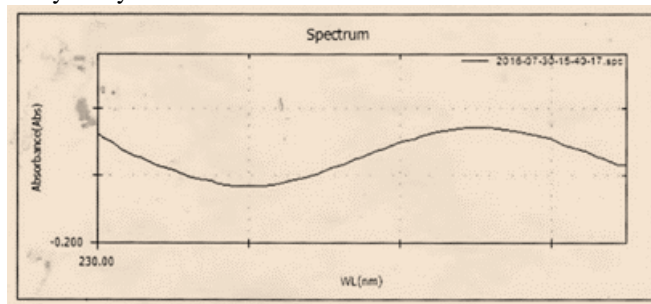


Fig. 1: UV Spectrum of FTS1

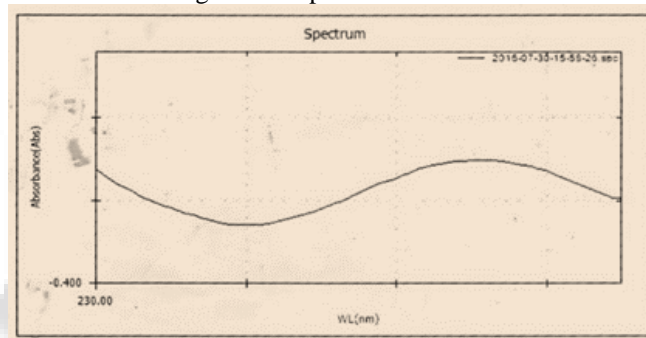


Fig. 2: UV Spectrum of FTS2

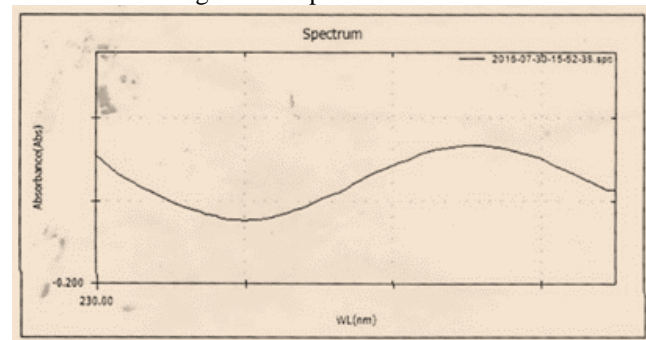


Fig. 3: UV Spectrum of FTS3

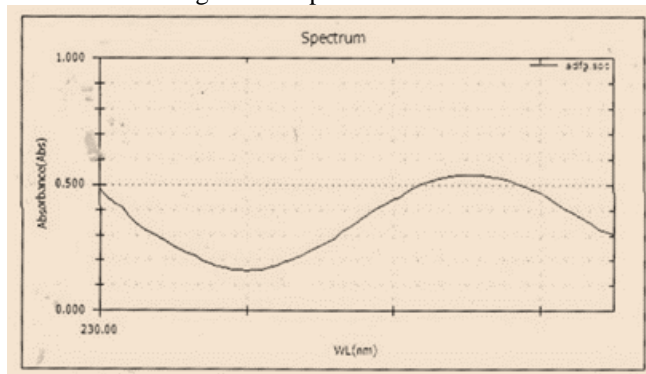


Fig. 4: UV Spectrum of ETS1

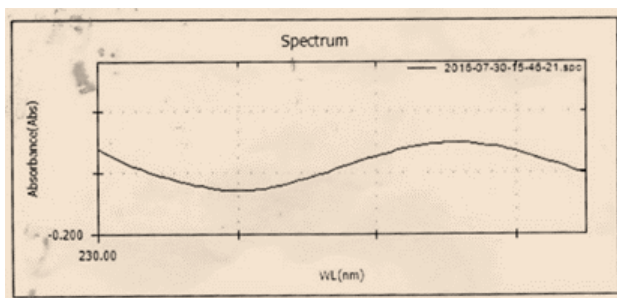


Fig. 5: UV Spectrum of ETS2

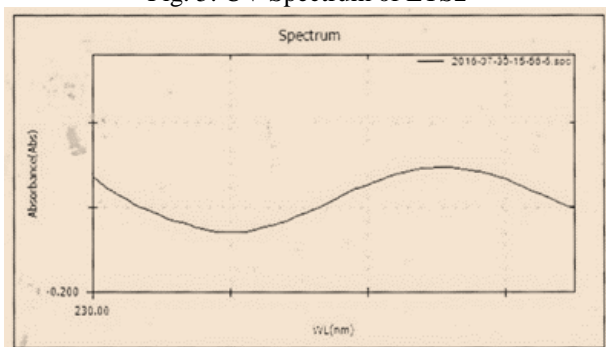


Fig. 6: UV Spectrum of ETS3

**D. Disintegration Test:**

As per IP while analysis enteric coated tablets did not get effect in acidic medium but undergo disintegration within 1 h in phosphate buffer solution. The determination showed that ETS<sub>1</sub> had maximum disintegration time 18.5min. Thus having greater resistance for phosphate buffer medium in comparison to ETS<sub>3</sub> at 14.1min. The results is shown in table 4.

S. No.	Sample code	0.1 N HCL	Phosphate buffer 6.8
1.	ETS <sub>1</sub>	No signs of cracks	18.5 min.
2.	ETS <sub>2</sub>	No signs of cracks	14.6 min.
3.	ETS <sub>3</sub>	No signs of cracks	14.1 min.

Table 4:

**E. Dissolution studies:**

As per USP drug release of Sustained release film coated tablets are 15% to 35% in 1 hr, 45% to 65% in 5hr, 65 % to 85% in 10h, 75% to 95% in 16 h, not less than 80 % in 24 h. Enteric coated tablets dissolution limit should not less than 75%. All the samples of both sustained release and enteric coated release drug within the limit. The result of dissolution of each sample at maximum wavelength are shown in table 5 and 6.

FTS <sub>1</sub>		FTS <sub>2</sub>		FTS <sub>3</sub>	
Absorbance	Drug release (%)	Absorbance	Drug release (%)	Absorbance	Drug release (%)
0.116	27.26	0.102	27.09	0.115	27.52
0.114	27.28	0.106	28.15	0.118	28.23

0.108	25.84	0.110	29.21	0.112	26.80
0.120	28.71	0.101	26.82	0.118	28.23
0.119	28.47	0.102	27.09	0.122	29.19
0.109	26.08	0.108	28.68	0.121	28.95

Table 5:

ETS <sub>1</sub>		ETS <sub>2</sub>		ETS <sub>3</sub>	
Absorbance	Drug release (%)	Absorbance	Drug release (%)	Absorbance	Drug release (%)
0.317	85.59	0.307	82.89	0.398	107.46
0.314	84.78	0.321	86.67	0.399	107.70
0.316	85.32	0.307	82.89	0.324	87.48
0.327	88.29	0.318	85.86	0.325	87.75
0.327	88.29	0.327	88.29	0.334	90.18
0.324	87.48	0.320	86.40	0.332	89.64

Table 6:

**IV. CONCLUSION**

Oral release of coated drugs depends on their dissolution rate in the absorption site. Thus, the aim set by the pharmaceutical companies for all kind of the tablets were achieved with huge attainment. Different samples of modified release tablets compared using IP and USP standards. The identification, uniformity of weight variation, percentage assay, disintegration and percentage drug release were found within the range. The dissolution studies showed that diclofenac sodium was slowly released in sustained release tablet compared to enteric coated tablet. Percentage of drug released and percentage assay of all samples were found within limit.

**ACKNOWLEDGEMENT**

We are very grateful to Dr. J.S. Chauhan Director S.A.T.I., Vidisha, Mr. J. P. Saxena Officer Incharge, Drug Testing Laboratory and Mr. Ajay Atre Food and Drugs Lab. Bhopal, for helping to carry out our analytical work.

**REFERENCES**

- [1] Anti-inflammatory and Pain-Reducing Drugs Copyright by Delmar Learning, a division of Thomson Learning, Inc.; 2004.
- [2] Zhang J, Tan X, Gao J, Fan W, Gao Y, Qian S, Journal of Pharm Pharmacol.; 65(1):44-52, Jan-2013.
- [3] Dai C, Stafford RS, Alexander GC. National trends in cyclooxygenase-2 inhibitor use since market release: nonselective diffusion of a selectively cost-effective innovation. Arch Intern Med; 165:171-7, 2005.

- [4] Brodgen RN, Heel RC, Pakers GE, Speight TM and Avery GS. Diclofenac sodium: a review of its pharmacological properties and therapeutic use in rheumatic diseases and pain of varying origin. *Drugs*; 20:24-48, 1980.
- [5] Leon Lachman, Herbert A Lieberman and Joseph L. Kanig, *The Theory and Practice of Industrial Pharmacy*, pp. 293-294.
- [6] PORTER, S. C. Coating of pharmaceutical dosage forms. In: GENNARO, A. R. (Ed.). *Remington's the science and practice of pharmacy*. 21. ed. Philadelphia: Lippincott Williams and Wilkins, pp.894, 2000.
- [7] Sinha M, Gautam L, Shukla PK, Kaur P, Sharma S, Singh TP. Current perspectives in NSAID-induced gastropathy. *Mediat Inflamm.* : 258209, 2013.
- [8] BIJU, S. S.; SAISIVAM, S.; RAJAN, M. G.; MISHRA, P. R. Dual coated erodible microcapsules for modified release of Diclofenac sodium. *Eur. J. Pharm Biopharm.*, v.58, n.1, pp.61-67; 2004.
- [9] HOGAN, J. E. Modified release coating. In: COLE, G.; HOGAN, J. E.; AULTON, M. (Eds.). *Pharmaceutical coating technology*. London: Taylor & Francis Books, pp.409-438; 1995.
- [10] Vyas S.P., Khar R.K., *Controlled Drug Delivery Concepts and Advances*, first ed. Vallabh Prakashan, India, pp.23-25; 2002.
- [11] Rosen H, Aribat T. The rise and rise of drug delivery. *Nat Rev Drug Discov.* 4(5):pp.381-385; 2005.
- [12] Derry P, Derry S, Moore RA, Mc Quay HJ. Single dose oral diclofenac for acute postoperative pain in adults. *Cochrane Database Syst Rev.*, 2:CD004768; 2009.
- [13] *Indian Pharmacopoeia volume (II)*, published by controller of publication in Delhi Govt. of India; Ministry of Health & Family Welfare, pp- 402: 44-47: 404; 2007.
- [14] *Indian Pharmacopoeia volume (II)*, published by controller of publication in Delhi. Govt. of India; Ministry of Health & Family Welfare: pp- 187-188; 1996.
- [15] *United State Pharmacopoeia / (National formulary) NF volume (II)*, published by United States convention, pp- 2124-2125; 2009.