International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 6 Nov-Dec 2023, pp: 2560-2565 www.ijprajournal.com ISSN: 2249-7781

Formulation and Evaluation of Transdermal Patches by Using Enalapril Maleate

Keerthana devi N.S[1], Senthil kumar K.L[2], Gokulan P.D[3], Nandha kumar. K.E[4], Nandhini. N[4], Naveen. C[4]

[1]*Associate professor, Sri vijay vidyalaya college of pharmacy, Dharmapuri, Tamilnadu.*
[2]*Principal, Sri vijay vidyalaya college of pharmacy, Dharmapuri, Tamilnadu.*
[3]*Professor, Sri vijay vidyalaya college of pharmacy, Dharmapuri, Tamilnadu.*
[4]*B. Pharm students, Sri vijay vidyalaya college of pharmacy, Dharmapuri, Tamilnadu.*

Submitted: 20-12-2023 Accepted: 30-12-2023

ABSTRACT
Transdermal drug delivery has made an important contribution to medical practice, but has yet to fully achieve its potential as an alternative to oral delivery. The transdermal formulation was prepared by polymers like combination of HPMC K100 and EC. Various polymers like PVP,PEG and propylene glycol etc. The prepared patches were evaluated for various physiochemical properties like Film thickness, Weight variation, Folding endurance, Moisture content and Drug content. The result of study shows the Enalapril maleate could be administered transdermally through the matrix type TDDS for effective control of hypertension, angina pectoris and congestive heart failure.

Keywords: Transdermal patch, Enalapril maleate, HPMC K100, EC, Poly vinyl pyrrolidone.

I. INTRODUCTION

Controlled drug delivery system is defined as any drug delivery system that maintains adequate and desired release of drug over an extend period of time. Hydrophilic polymer matrix is extensively used polymer for making formulation. Transdermal drug delivery system (TDDS) is a topically administered system in the form of patches or semisolids (gels) that deliver drugs for the systemic effects at a predetermined and controlled rate. Transdermal drug delivery system has many advantages over conventional modes of drug administration, it avoids hepatic metabolism, ease of termination and long duration of action. Study has been carried out to provide an Anti-hypertensive drug in transdermal patches.

Enalapril maleate is belongs to class of ACE inhibitors and it's a prodrug which when administered orally, hydrolyzed to release the active coverting enzyme inhibitor enalaprilat. Enalapril maleate is 60% absorbed and 40% bioavailable as enalaprilat.

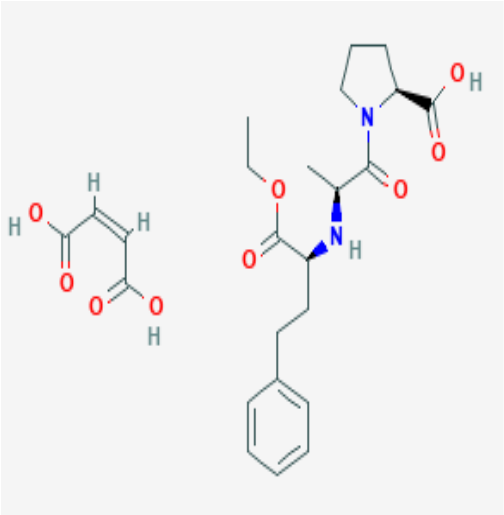


Figure 1: Structure of Enalapril Maleate.

It can be used for treatment of hypertension and sympathomatic congestive heart failure. After oral administration, the elimination half life is <2 hrs for unchanged form and average half life is 35-38 hrs.

II. MATERIALS AND METHODS

The polymers poly vinyl pyrollidone and poly ethylene glycol was brought from Bangalore fine chemicals. Ethyl cellulose, Glycerol, Propylene glycol were brought from isochem laboratories.

Preparation of standard graph of enalapril maleate

A spectrophotometric method based on the measurement of absorbance at 206 nm in phosphate buffer of pH 7.2 was used in the present study for

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 6 Nov-Dec 2023, pp: 2560-2565 www.ijprajournal.com ISSN: 2249-7781

the estimation of Enalapril maleate in the formulations.

The standard solution of enalapril maleate was subsequently diluted with phosphate buffer of pH 7.2 to obtain a series of dilutions containing 2, 4, 6, 8 and 10µg of Enalapril maleate in 1ml solution. The absorbance of these solutions was measured in UV-Vis Spectrophotometer at 206 nm using phosphate buffer of pH 7.2 as blank.

Preparation of flims

Matrix films are casted on glass mould (petri plate) by solvent casting method. Three types transdermal films were prepared as the formula. All the three formulations contain propylene glycol as the plasticizer. Polymers HPMC K100 and EC were dissolved in 4ml of methanol until it forms a homogeneous solution. Then the drug [Enalapril maleate] was added slowly in the polymeric solution and stirred on the magnetic stirrer to obtained a uniform solution. To this solution required amount of drug was added, and subsequently PG and PVP were added keeping the drug concentration constant in each formulation and stirred continuously to form a homogenous mixture. The solution was poured into the petridish and dried at room temperature for 24 hrs. An inverted funnel was placed over the mould to prevent fast evaporation of the methanol. Patches were prepared by cutting and packed in an aluminium foil and stored in a desiccators until further use.

Formulation code	Enalapril Maleate (mg)	Ethyl cellulose (mg)	HPMC K100 (mg)	PVP (mg)	PEG (ml)	PG (ml)	Methanol (ml)
F1	15	70	80	100	50	2	4
F2	15	50	60	75	50	2	4
F3	15	100	100	50	50	2	4

Table 1: Formulation of transdermal films

EVALUATION OF TRANSDERMAL FILMS

PHYSIOCHEMICAL EVALUATION

1. Physical Appearance

All the prepared transdermal patches were visually inspected for clarity, colour, flexibility and smoothness.

2. Film Thickness

The thickness of prepared patch was measured at three different places using a screw gauge and mean values were calculated.

3. Weight Variation

Weight variation was studied by individually weighing 3 randomly selected films. Such determination was performed for each formulation.

4. Folding Endurance

A strip of specific area of film was taken evenly and repeatedly folded at the same place till it broke. The number of times the films could be folded at the same place without breaking gave the value of the folding endurance.

5. Moisture Content

To check the physical stability of the film in high humidity conditions, accurately weighed films were placed in dessicator containing saturated solution of aluminium chloride (79.5% RH) for three days. The films were re-weighed and the percentage moisture absorption was calculated using the formula.

$$\text{Moisture content} = \frac{\text{Final weight} - \text{Initial weight} \times 100}{\text{Initial weight}}$$

6. Drug Content

The film of specified area was cut and added to a beaker containing 100 ml phosphate

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 6 Nov-Dec 2023, pp: 2560-2565 www.ijprajournal.com ISSN: 2249-7781

buffer pH 7.2. the medium was stirred (500 rpm) with Teflon coated magnetic bead for 5 hrs. The contents were filtered using whatman filter paper and the filterate was analysed by U.V. spectrophotometer at 206 nm for the drug content against the blank solution.

III. RESULT AND DISCUSSION

STANDARD PLOT OF ENALAPRIL MALEATE

The standard curve of emalapril maleate in phosphate buffer pH 7.2 was obtained as follows:

Table 2: Spectrophotometric data for construction of standard graph of enalapril maleate

Concentration(µg/ml)	Absorbance
2	0.15
4	0.30
6	0.44
8	0.60
10	0.75
12	0.89

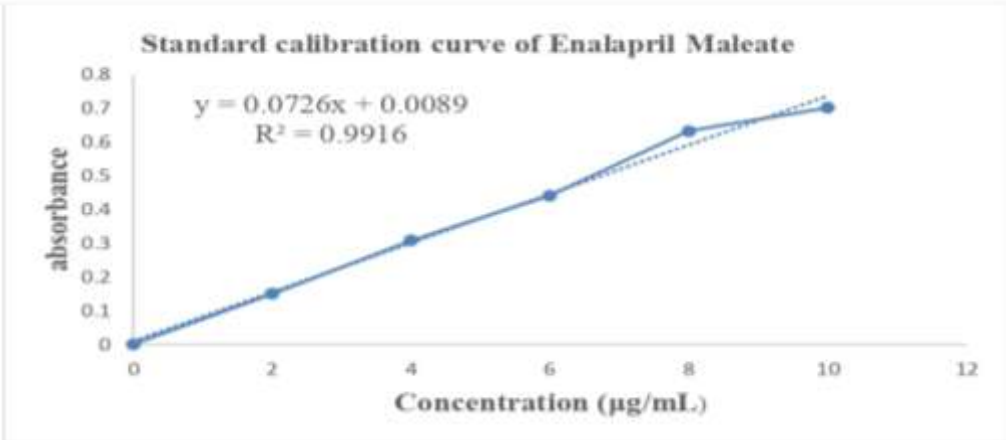
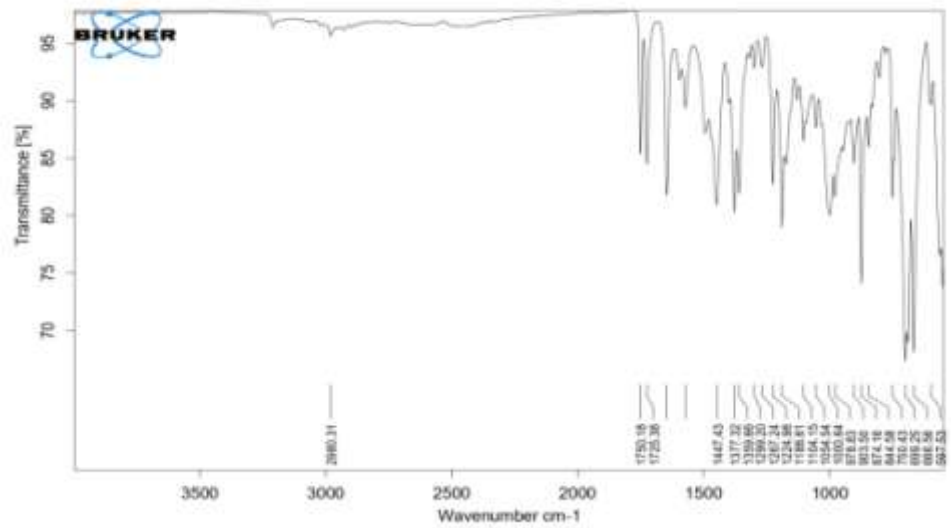


Figure 2: Standard calibration curve

FT-IR SPECTROSCOPIC STUDY

IDENTIFICATION OF ENALAPRIL MALEATE BY FTIR SPECTROSCOPY:



International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 6 Nov-Dec 2023, pp: 2560-2565 www.ijprajournal.com ISSN: 2249-7781

Figure 3: FTIR spectrum of pure drug Enalapril Maleate

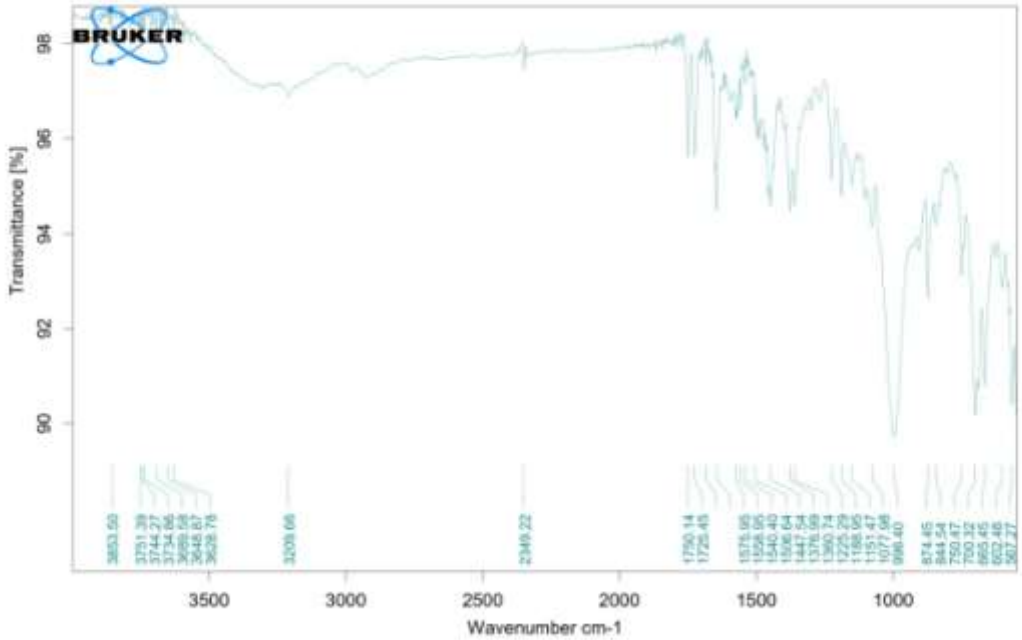


Figure 4: FTIR Spectrum of pure drug Enalapril Maleate and HPMC K100

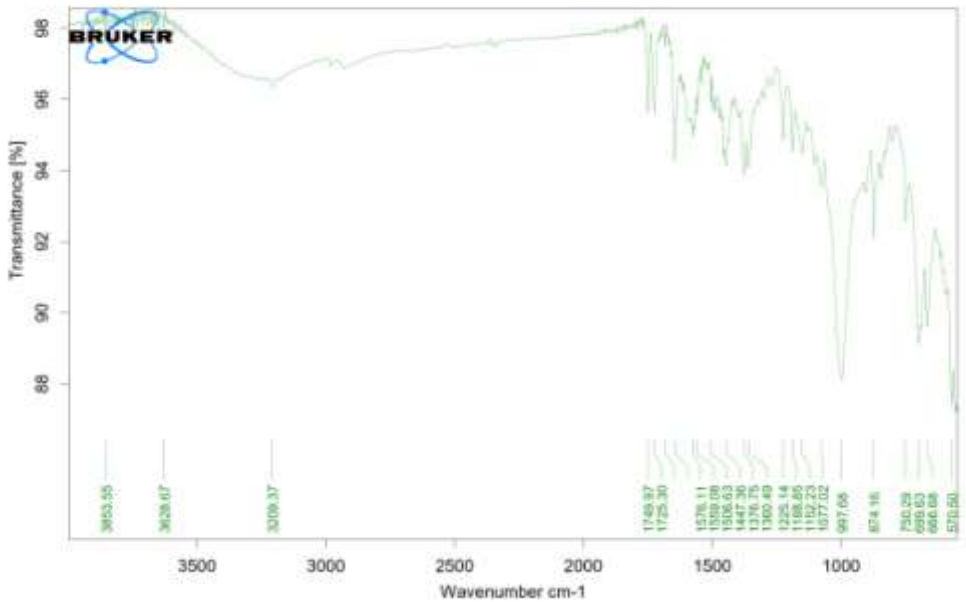


Figure 5: FTIR Spectrum of pure drug Enalapril Maleate and EC

EVALUATION STUDIES

1. PHYSICAL APPEARANCE

The patches were visually inspected for colour, clarity, flexibility, thickness and smoothness.

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 6 Nov-Dec 2023, pp: 2560-2565 www.ijprajournal.com ISSN: 2249-7781

Table 3: Physical Appearance of Enalapril maleate patches.

FORMULATION CODE	COLOUR	CLARITY	FLEXIBILITY	SMOOTHNESS
F1	Colourless	Clear	Flexible	Smooth
F2	Colourless	Clear	Flexible	Smooth
F3	Colourless	Clear	Flexible	Smooth

2. FILM THICKNESS

The thickness of patches was determined by using screw gauge. The mean thickness was measured at different points of the film.

Table 4: Thickness of sample of Enalapril maleate patch.

S.NO	FORMULATION CODE	MEAN THICKNESS (mm)
1	F1	0.259
2	F2	0.245
3	**F3**	**0.272**

3. WEIGHT VARIATION

The weight variation of the sample is given below in the **Table 5**

Table 5: Weight variation of Enalapril maleate patch

S.NO	FORMULATION CODE	MEAN WEIGHT (gm)
1	F1	593
2	F2	590
3	**F3**	**598**

4. FOLDING ENDURANCE

The folding endurance of the sample is given below in the **Table 6**

Table 6: Folding endurance of Enalapril maleate patch

S.NO	FORMULATION CODE	FOLDING ENDURANCE
1	F1	27
2	F2	26
3	**F3**	**30**

5. MOISTURE CONTENT

The percentage moisture content of the samples are given below in the **Table 7**

Table 7: Percentage moisture content of Enalapril maleate patch

S.NO	FORMULATION CODE	PERCENTAGE MOISTURE CONTENT (%)
1	F1	5.12%
2	F2	5.2%
3	**F3**	**3.77%**

6. DRUG CONTENT

The drug content of the samples are given below in **Table 8**

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 6 Nov-Dec 2023, pp: 2560-2565 www.ijprajournal.com ISSN: 2249-7781

Table 8: Drug content of Enalapril maleate patch

S.NO	FORMULATION CODE	PERCENTAGE DRUG CONTENT (%)
1	F1	92%
2	F2	80%
3	**F3**	**98%**

IV. CONCLUSION

Transdermal patches of Enalapril Maleate can be successfully prepared by using HPMC and EC as individual polymer film and in combination by solvent casting method. The formulation **F3** was found to be best among all batches with a consisting release rate for 24 hours for the management of hypertension and sympathomatic congestive heart failure. It was found that there was an increase in the drug release by increasing the concentration of hydrophilic polymer HPMC.

Hence, it was concluded the Enalapril maleate transdermal patches may prove to be potential candidate for safe and effective controlled drug delivery over an extended period of time.

REFERENCE

[1]. Kushal M, Monali M, Durgavati M, Mittal P, Umesh S, Pragna S. Oral controlled release drug delivery system: An overview. Int Res J of Pharm. 2013;4(3):70-6.

[2]. Heather A.E. Benson. Transdermal drug delivery. Penetration enhancement techniques.J. current drug delivery. 2005;2:23-33.

[3]. Davies RO, Gomez HJ, Irvin JD, Walker JF. An Overview of the clinical pharmacology of Enalapril. Br J Clin Pharmacol. 1984;18(S2):215S-29S.

[4]. Rastogi et.al. A brief review on antihypertensive drug delivery through transdermal patches. International J. Pharm sci., 2012;3:1955-1970.

[5]. Kulkarni RV, Mutalik S, Hiremath D. Effect of plasticizers on the permeability and mechanical properties of eudragit films for transdermal application. Indian Journal of Pharmaceutical Sciences. 2002;64(1):28.

[6]. Misra A, Upadhyay P. Appratus for preparing adhesive-depression transdermal patches on a laboratory scale. International journal of Pharmaceutics. 1996;132(1-2):267-70.

[7]. Misra A, Majumdar SS, Talwar GP, Singh O. Biphasic testosterone delivery profile observed with two different transdermal formulations. Pharm Res. 1997;14:1264-1268.

[8]. Rao MY, Vani G, Chary BR. Design and evaluation of mucoadhesive drug delivery systems. Indian Drugs 1998;35:558-565.

[9]. Liu Y, Fang L, Zheo L, Ge X, He Z Development and invitro evaluation of topical use patch containing Diclofenac diethanolamine salt. Asian journal of Pharmaceutical sciences, 2007;106-113.

[10]. www.drugbank.ca/drugs/DB0058.