CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES
SJIF Impact Factor: 7.187
https://doi.org/10.5281/zenodo.21264819

Available online at: http://www.iajps.com Research Article

FORMULATION AND EVALUATION OF BUPRENORPHINE TRANSDERMAL PATCHES BY USING NATURAL POLYMER

Kundavarapu Narendra[1], A. Gopireddy*[2], Indira Revathi[1], Annapureddi[1]

[1]Assistant Professor, Department of Pharmaceutics, Sana College of Pharmacy, Kodad, Telangana 508206

[2]Professor, Department of Pharmaceutical Chemistry, Sana College of Pharmacy, Kodad, Telangana 508206.

Abstract:

The objective of present study was to develop matrix type transdermal therapeutic systems of Buprenorphine using various such as chitosan and tragacanth gum polymers as matrix formers. Results revealed that prepared patches showed good physical characteristics, no drug-polymer interaction. The in vitro release study revealed that F4 formulation showed maximum release in 8 hrs. Formulation F4 was subjected for accelerated stability studies. The F4 formulation was found to be stable as there was no drastic change in the Physico-chemical properties of the patches, which was also confirmed by FTIR. Thus conclusion can be made that stable transdermal patches of has been developed. F4 formulation showed highest cumulative percentage drug release of 95.90% were obtained during in vitro drug release studies after 8 hrs. The release of Buprenorphine appears to be dependent on lipophilicity of the matrix. Moderately lipophillic matrices showed best release. The predominant release mechanism of drug through the fabricated matrices was believed to be by diffusion mechanism. Based upon the in vitro dissolution data the F4 formulation was concluded as optimized formulation.

Key words: *Buprenorphine, Chitosan, tragacanth gum solvent casting technique, in vitro drug release studies.*

Corresponding author:

A.Gopireddy,
Professor,
Department of Pharmaceutical Chemistry,
Sana College of Pharmacy,
Kodad, Telangana 508206.

QR CODE

Please cite this article in press Sayed Shaffath Ali et al ***Formulation And Evaluation Of Buprenorphine Transdermal Patches By Using Natural Polymer****, Indo Am. J. P. Sci, 2026; 13(07).*

1. INTRODUCTION:

Transdermal drug delivery systems provide for the controlled release of drugs directly into the bloodstream through intact skin. [1]Transdermal delivery can provide a number of advantages over conventional methods of drug administration, including enhanced efficacy, increased safety, greater convenience and improved patient compliance[2]. By delivering a steady flow of drugs into the bloodstream over an extended period of time, transdermal systems can avoid the "peak and valley" effect of oral or injectable therapy and can enable more controlled, effective treatment[3]. By avoiding first pass metabolism through the gastrointestinal tract and the liver, the therapeutically equivalent dosage the transdermal delivery of certain compounds can be significantly less than the corresponding oral dosage, potentially reducing dosage related side-effects[4].Today transdermal patches are widely used to deliver hormones and pain management medications. The basic process involved in the development of transdermal drug delivery systems (i.e., patches) is percutaneous or transdermal absorption[5].

Transdermal delivery may also eliminate the side effects that some drugs cause when presented in conventional forms. Transdermal drug delivery systems (TDDS), also known as patches, are dosage forms designed to deliver a therapeutically effective amount of drug across a patient's skin[6]. They are defined as self-contained, discrete dosage forms which, when applied to the intact skin, deliver the drug(s), through skin at a controlled rate to systemic circulation (monk house, 1988)[7]. In order to deliver therapeutic agents through the human skin for systemic effects, the comprehensive morphological, biophysical and physicochemical properties of the skin are to be considered.[8]The purpose of this study was to develop formulations and systematically evaluate in-vitro diffusion studies of transdermal patches of Buprenorphine using Natural polymer and choose the polymer to develop the release of drug in immediate and sustained manner.

2.MATERIALS AND METHODS:

2.1 MATERIALS

Buprenorphine was collected as a gift sample from Hetero laboratories, Hyderabad, Synthetic polymers, super disintegrants and other excipients were purchased from Synpharma Research Labs, HYD.

2.2 METHODODOLOGY

Formulation development

Table-1: Formulation table

S. No	Formulation code	Ingredients (mg)		
		Drug (mg)	Tragacanth gum	Chitosan
1	F1	10	50	-
2	F2	10	100	
3	F3	10	-	50
4	F4	10	-	100

Preparation of transdermal patches:

Transdermal patches containing Buprenorphine were prepared by the solvent casting evaporation technique. The drug Buprenorphine was dissolved in suitable solvent. Polymers Tragacanth gum and Chitosan were taken in a boiling tube, to this add Buprenorphine drug which was previously dissolved in methanol. PEG was taken as a plasticizer, and added to the mixture and mixed well. It was set aside for 2 hours to exclude any entrapped air and was then transferred into a previously cleaned petri plate (40cm^2), drying of patches was carried out in vacuum oven at room temperature. Dried patches were packed in aluminium foil and stored in a desiccator for further evaluation.

FT-IR study[9]

Compatibility studies of Apomorphine and the disintegrants were carried out by using Fourier Transform Infrared Spectroscopy (FTIR). Fourier transform infrared spectra of the samples were obtained in the range of 4000 to 450 cm-1 using a FTIR by the KBr disc method.

Evaluation parameters[10,11,12,13]

Physical appearance:

All the prepared transdermal films were observed for color, clarity, flexibility, and smoothness.

Folding endurance:

Folding endurance of the patches was determined by repeatedly folding at the same place till it broke. The number of times the patch could be folded at the same place without breaking is the folding endurance. This was repeated on all the patches for three times and the mean values plus standard deviation was calculated.

Thickness of the film :

The thickness of each film was measured by using screw gauze. The thickness was measured at three different places on each film and the average thickness of the film was taken as the thickness of the film.

Weight uniformity:

The prepared patches are to be dried at 60^{0}C for 4hrs before testing. A specified area of 4.52 cm^2 of patch is to be cut in different parts of the patch and weigh in digital balance. The average weight and standard deviation values are to be calculated from the individual weights.

Drug content :

The formulated transdermal films were assayed for drug content in each case. Three patches from each formulation were assayed for content of drug. Each formulation was casted in triplicate and one film from each was taken and assayed for content of drug.

Moisture absorption studies:
The films were weighed accurately and placed in a desiccators containing aluminium chloride to maintain 79.50% RH. After 3 days, the films were taken out and weighed. The percentage of moisture uptake was calculated using the following formula.

$$\text{Perentage moisture uptake} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Initial weight}} \times 100$$

Moisture loss studies :
Three films were weighed individually and kept in a desiccator containing calcium chloride at 37^{0}C for 24 hrs. Then the final weight was noted when there was no further change in the weight of the patch. The percentage of moisture loss was calculated using the following formula.

$$\text{Percentage moisture loss} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Final weight}} \times 100$$

***In-vitro* Drug release studies:**
The *in-vitro* study of drug permeation through the Dialysis membrane was performed using a modified Franz type glass diffusion cell. The modified cell having higher capacity is (10 ml) is used to maintain sink condition. The samples were analyzed for drug content spectrophotometrically. The receptor phase was replenished with an equal volume of phosphate buffer at each sample withdrawal.
Percentage of drug release was determined using the following formula.

$$\text{Perentage drug release} = \frac{Da}{Dt} \times 100$$

Where, Dt = Total amount of the drug in the patch
Da = The amount of drug released

Stability studies:

Optimized medicated films were subjected to short term stability testing. The transdermal films were sealed in aluminium foils and kept in a humidity chamber maintained at 40 ± 2 ^{0}C and 75 ± 5% RH for 1 month as per ICH guidelines.

3.RESULTS AND DISCUSSION:

Drug - excipient compatibility studies (FT-IR)
FT-IR Spectra of Buprenorphine and excipients were recorded. All these peaks have appeared in formulation and physical mixture, indicating no chemical interaction between Buprenorphine and polymers.

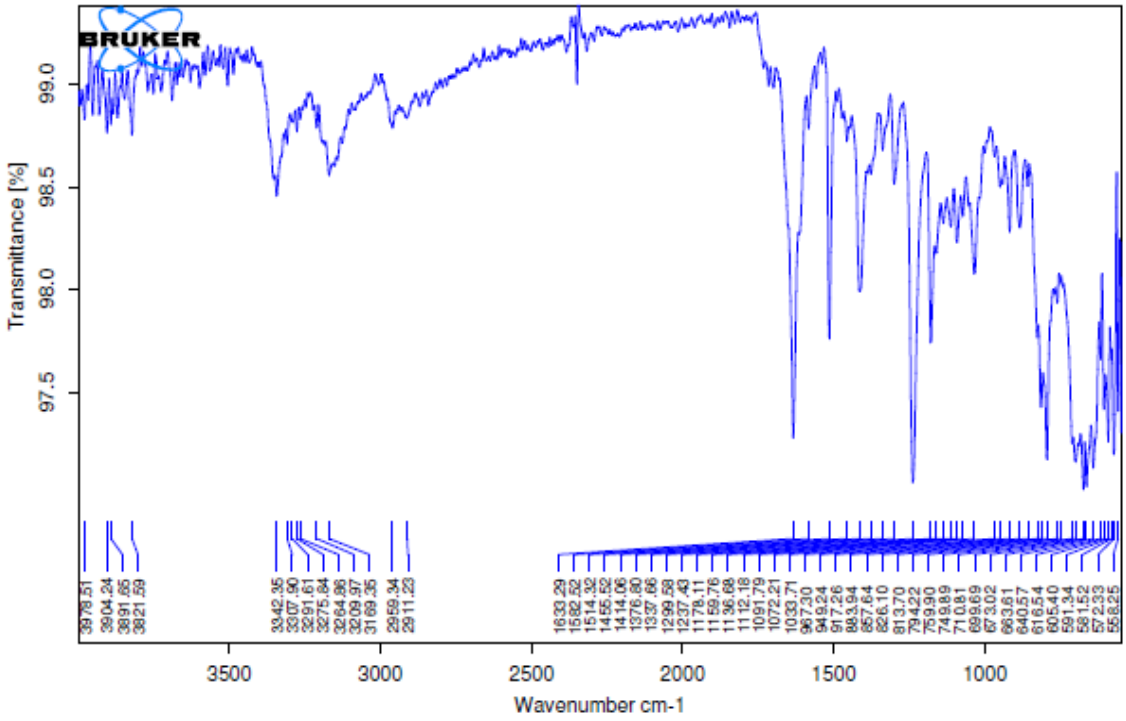

Fig-1: FTIR Spectra of Buprenorphine

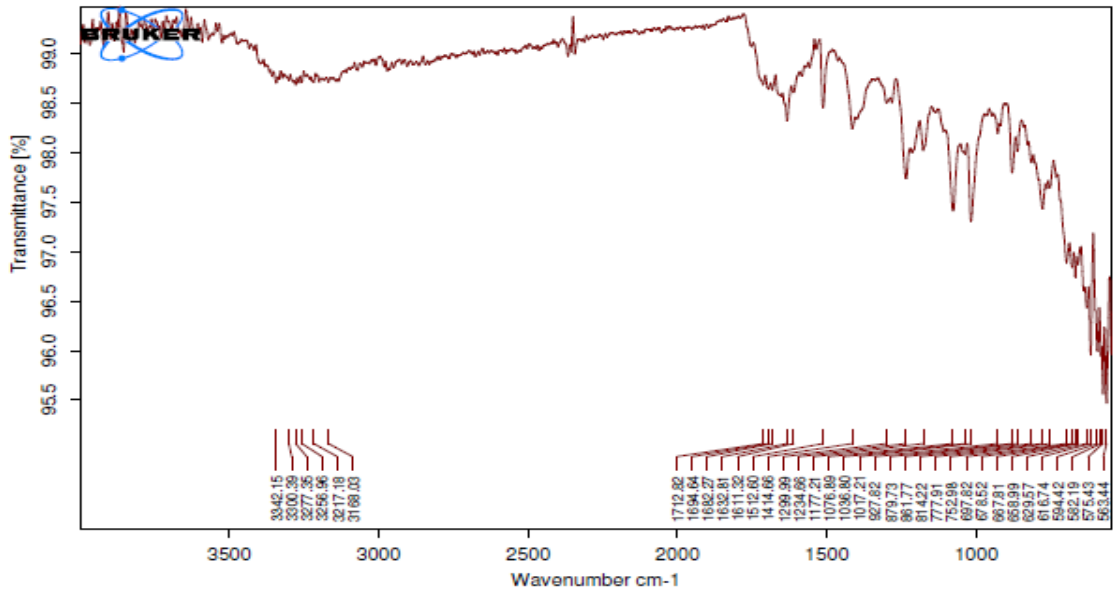

Fig-2: FTIR Spectra of Optimized formulation

Compatibility studies were performed using IR spectrophotometer. The IR spectrum of Pure drug and physical mixture of drug and excipients were studied. The characteristic absorption of peaks were obtained as above and as they were in official limits (±100 cm-1) the drug is compatible with excipients.

Evaluation of Transdermal formulation

Physical appearance:
The prepared patches were found to be uniform, smooth, flexible and homogenous.

Folding endurance:
The folding endurance numbers of all the Buprenorphine patches are 158-167. The folding endurance number gives the mechanical property of the patches, high folding endurance number indicate that has high mechanical property. The folding endurance number was increased with increasing the chitosan content. These results indicated that the patches would not break and maintain their integrity with general skin folding when applied.

Thickness of the film:
Thickness was changed from batch to batch in individual strips of medicated patch carry uniform thickness, which indicates that total medicated patch carry uniform thickness..

Weight uniformity:
The weights are in the range of 228.12 to 240.25. The F4 formulation patches showed maximum weight.

Drug content:

The drug content analysis of the prepared formulations have shown that the process employed to prepare the patches was capable of giving uniform drug content with minimum batch variability. All the patches were found to have drug content in the range of 90 – 101%. So the method employed i.e. solvent evaporation method is satisfactory for the preparation of Buprenorphine transdermal patches.

Table-2: Physicochemical evaluation of Buprenorphine patches

Formulation code	Weight (mg)	Thickness (mm)	Folding endurance	Drug content (%)	% moisture loss	% moisture absorption
F1	228.12	0.89	160	92.30	8.90	8.95
F2	239.16	0.90	159	95.69	9.20	9.15
F3	240.25	0.86	168	90.50	10.25	11.26
F4	238.15	0.92	165	93.45	11.20	9.99

***In vitro* release study:**

Phosphate buffer pH 7.4 was used as medium for the release studies and good linearity was observed in the plotted standard graph with a correlation coefficient of 0.998. The drug release profiles of Buprenorphine patches containing different ratios of polymers Tragacanth and chitosan It was cleared from the release profiles of formulations, that the drug release was governed by polymer nature and content.

Table-3: *In vitro* drug release profiles of Buprenorphine transdermal patch (F1-F4)

Time	F1	F2	F3	F4
0	0	0	0	0
1	22.42	25.21	22.18	21.45
2	30.45	35.18	36.25	29.52
3	42.8	46.4	43.44	38.6
4	51.22	52.32	50.28	49.2
5	60.58	61.65	59.99	57.48
6	72.85	73.51	68.22	69.1
7	82.4	83.89	81.25	72.85
8	90.58	92.9	90.19	95.69

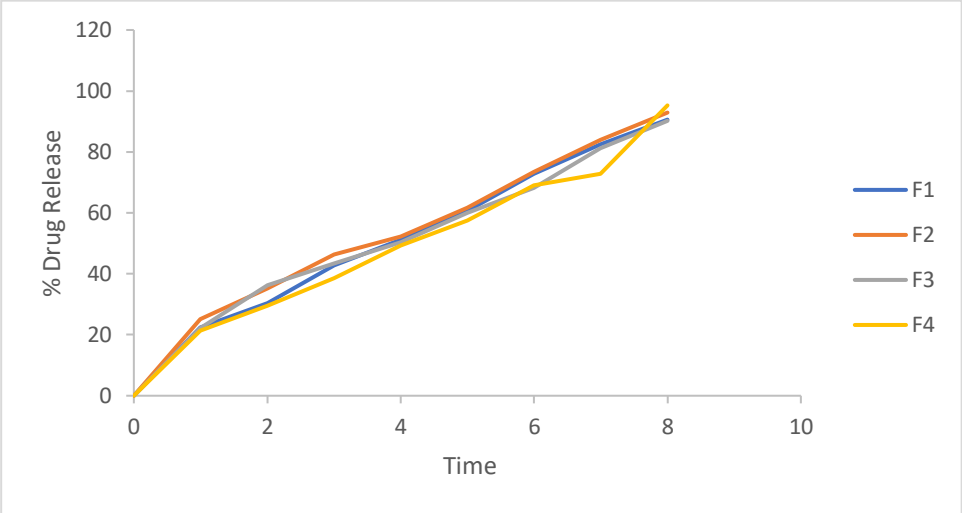

Fig-3: Drug release graph

Stability studies

Optimized formulations F4 was selected for accelerated stability studies as per ICH guidelines. The patches were observed for color, appearance and flexibility for a period of three months. The folding endurance, weight, drug content, % cumulative drug release of the formulation was found to be decreasing. This decrease may be attributed to the harsh environment (40^0C) maintained during the studies.

Table-4: Stability studies of optimized formulations at 40 ± 2 ^{0}C and 75 ± 5% RH for 3 months

Time in days	Drug content (%)	Folding endurance	Physical appearance	% Cumulative drug release
0	95.69	158	No change in color	92.90
30	95.58	168	Slight yellowish color	92.85

4.CONCLUSION:

The following conclusions could be drawn from the results:Results revealed that prepared patches showed good physical characteristics, no drug-polymer interaction and no skin irritation was observed. The F4 formulation was found to be stable as there was no drastic change in the Physico-chemical properties of the patches, which was also confirmed by FTIR. Thus conclusion can be made that stable transdermal patches of Buphrenorphine has been developed. F4 formulations showed highest cumulative percentage drug release of 95.69 %, were obtained during *in vitro* drug release studies after 8 hrs. The release of Buphrenorphine appears to be dependent on lipophilicity of the matrix. Moderately lipophillic matrices showed best release. The predominant release mechanism of drug through the fabricated matrices was believed to be by diffusion mechanism. Based upon the *in vitro* dissolution data the F4 formulation was concluded as optimized formulation.

5. REFERENCES:

1. Vyas S.P and Khar R.K. Targetted and controlled Drug Delivery Novel carrier system1st ed. CBS Publishers and distributors, New Delhi, 2002; 411- 447.
2. Chein Y.W. Transdermal drug delivery and delivery system. In, Novel drug delivery system, Vol. 50, Marcel Dekker, Inc., New york, 1992 pp.301-381.
3. Martin A, Swabrik J, Cammarara A. Physical pharmacy. 4th ed. New delhi: B.I Vaverly Pvt Ltd; 1996: 264-8.
4. R.L Cleek, A.L Bunge, "A new method for estimating dermal absorption from chemical exposure.General approach", Pharm Res, Vol.10, 497–506, 1993.
5. Hadgraft, J., Guy, R., In; Transdermal Drug Delivery, Marcel Dekker, Inc., New York and Basel, Vol. 35, 296.
6. Misra, A.N., In; Jain, N.K., Eds., Controlled and Novel Drug Delivery, 1st ed. CBS Publishers and Distributors, New Delhi, 2002, 101-107.
7. Loyd v. allen, Jr. Nicholas G. popovich, howard C. Ansel. Pharmaceutical dosage form and drug delivery systems. 8th ed. Wolters kluwer publishers, New delhi, 2009; 298-315.
8. Ghosh, T.K., Pfister, W.R., Transdermal and Topical Drug Delivery Systems, *Int. Pharm., Press,* 39.
9. Berner B, John VA (February 1994). "Pharmacokinetic characterization of transdermal delivery systems". Clinical pharmacokinetics 26 (2): 121–34. PMID 8162656.
10. Shreeraj183: Transdermal drug delivery technology revisited: recent advances.
11. Breathnach AS. An Atlas of the Ultrastructure of Human Skin. London: Churchill, 1971.
12. Hashimoto K, Gross BG, Lever WF. The ultrastructure of the skin of human embryos. II. The formation of intradermal portion of the eccrine sweat duct and of the secretory segment during the first half of embryonic life. J Invest Dermatol 1966; 46: 513–29.
13. Roberts MS, Targeted drug delivery to the skin and deeper tissues: role of physiology, solute structure and disease.Clin Exp Pharmacol Physiol 1997 Nov; 24(11):874-9**.**