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TO STUDY AND EVALUATE TRANSDERMAL PATCH OF ETORICOXIB AS ANALGESIC (PAIN RELIEF) DRUG

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ABSTRACT

Transdermal drug delivery systems have emerged as an effective alternative to conventional oral dosage forms due to their ability to provide controlled drug release, improved patient compliance, and reduced gastrointestinal side effects. The present study focuses on the formulation and evaluation of a transdermal patch containing Etoricoxib, a selective COX-2 inhibitor widely used as an analgesic and anti-inflammatory drug. The objective of this research was to develop a stable and effective transdermal patch capable of delivering Etoricoxib through the skin for prolonged pain relief.

The transdermal patches were prepared using suitable polymers by the solvent casting method. Various physicochemical parameters such as thickness, weight variation, folding endurance, moisture content, moisture uptake, drug content uniformity, and surface pH were evaluated to ensure the quality and stability of the patches. In vitro drug release and diffusion studies were carried out to determine the release profile of Etoricoxib from the formulated patches. The prepared formulations showed satisfactory mechanical properties and uniform drug distribution. The optimized formulation demonstrated controlled and sustained drug release over an extended period, indicating its potential effectiveness in pain management.

The study concludes that Etoricoxib transdermal patches can serve as a promising alternative to oral administration by minimizing gastrointestinal irritation and enhancing therapeutic efficacy. The developed formulation may improve patient convenience and compliance in the long-term management of pain and inflammatory conditions. Further pharmacokinetic and clinical studies are recommended to confirm the safety and effectiveness of the developed transdermal system.

KEYWORDS: Etoricoxib, Transdermal Patch, Analgesic Drug,Controlled Drug Release, Pain Management;

INTRODUCTION

Transdermal drug delivery systems (TDDS) are an important alternative to traditional ways of giving medicines such as tablets or injections. These systems deliver the drug through the skin and into the bloodstream in a slow and controlled manner. Over the years, TDDS has grown in popularity because it offers a simple, painless, and convenient method of treatment—especially for drugs that need long-term or continuous dosing. The main reason transdermal patches work is because certain drugs can pass through the skin. Although the skin is a strong protective barrier, some drugs with suitable properties can cross it if formulated properly. By doing so, the drug avoids the digestive system and liver metabolism, which normally reduce the amount of active drug reaching the systemic circulation. Because of this, transdermal systems can provide better drug levels and fewer side effects compared to oral medications.

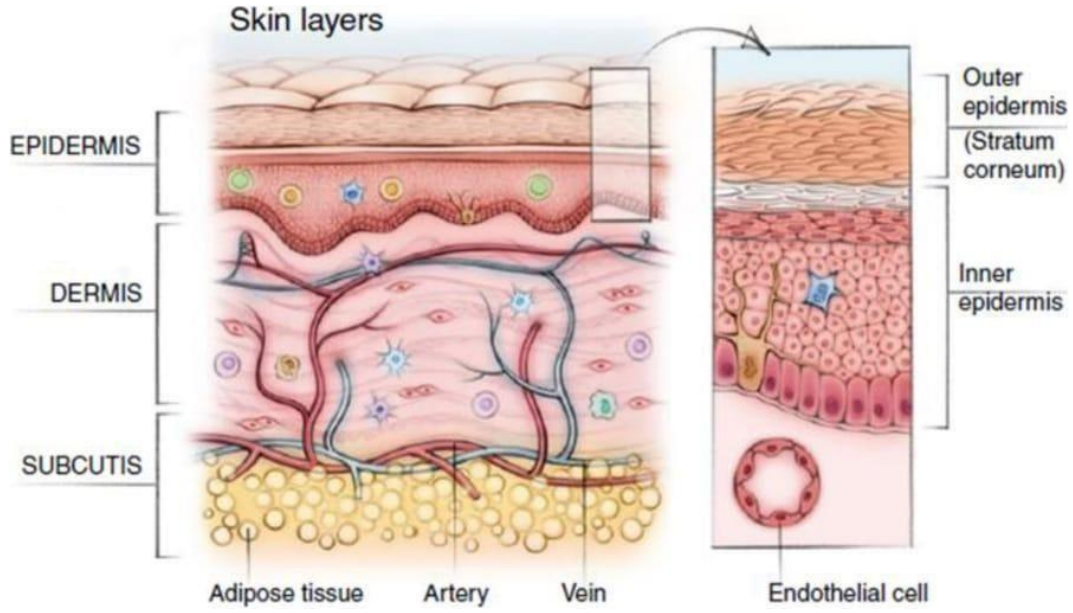

Fig. The Structure of Skin Consist of Three Layers.

1.2. Skin Structure and Its Importance in Drug Delivery

The skin is made up of three major layers:

- Epidermis – the outer protective layer
- Dermis – the middle layer containing nerves and blood vessels

- Hypodermis – the deeper fatty layer The most important part for drug delivery is the stratum corneum, the top layer of the epidermis. It is made of tightly packed dead cells surrounded by lipids, forming a strong barrier. Because of this structure, only drugs with certain properties—such as small size and good fat-solubility—can pass through it. This is why selecting the right drug is a crucial step in making a transdermal patch.

1.3. How Transdermal Drug Delivery Works

For a drug to enter the bloodstream through the skin, it must move from the patch, across the skin layers, and finally reach the blood vessels. The drug can cross the skin through three main pathways: o Through skin cells (transcellular) o Between skin cells (intercellular) o Through hair follicles and sweat glands (appendageal) o Many factors affect how well the drug passes through the skin, including: o Drug's solubility o Its ability to dissolve in skin lipids o The presence of enhancers that increase permeability

1.4. Advantages of TDDS

- Avoids chemically hostile GI environment (drug degradation in acidic and basic environments is prevented).
- No GI distress and the factors like Gastric emptying, intestinal motility, transit time, do not affect this route as in oral route.
- Avoidance of significant presystolic metabolism (degradation in GIT or by the liver) and therefore need lower doses.
- Allows effective use of drugs with short biological half-life. Allow administration of drugs with narrow therapeutic window because drug levels are maintained within the therapeutic window for prolonged periods of time.
- Reduced inter and intra patient variability.
- Enhance therapeutic efficacy, reduced fluctuations (rapid blood level spikes-low and high) due to optimization of blood concentration – time profile.
- Reduction of dosing frequency and enhancement of patient compliance. Provides controlled plasma levels of very potent drugs. Can provide adequate absorption of certain drugs.
- Avoids the risk and inconveniences of parenteral therapy (Painless method of drug administration). Drug input can be promptly interrupted simply by removal of the patch.

1.5. Challenges in Transdermal Drug Delivery

- Despite many benefits, TDDS also has limitations:
- Only drugs with specific properties can be delivered through the skin.
- Some individuals may develop skin irritation.
- Drugs that are too large or too water-soluble cannot easily pass through the skin.
- Skin conditions differ from person to person, affecting drug absorption.
- These challenges are often managed by using suitable polymers, permeation enhancers, and optimized formulation techniques.

1.6.Etoricoxib

Etoricoxib is a commonly used pain-relieving and anti-inflammatory drug. It belongs to a class known as COX-2 inhibitors. Doctors prescribe it for conditions like arthritis, back pain, tooth pain, and gout. Although effective, oral Etoricoxib can sometimes cause digestive system problems or undergo extensive metabolism, which reduces its availability.

1.7. Why Choose Etoricoxib for a Transdermal Patch

The decision to prepare Etoricoxib in a transdermal form is based on several reasons:
It requires a relatively small dose, making it suitable for TDDS.

- Its fat-soluble nature helps it cross the skin barrier.
- It can bypass the stomach, reducing irritation.
- A patch can offer steady and long-lasting pain relief.

1.9 Importance of Controlled Drug Release in Pain Treatment Pain management often requires medications to be taken repeatedly throughout the day. Oral NSAIDs cause fluctuations in blood levels, which can lead to poor pain control or increased side effects. A transdermal patch allows:

- Continuous drug delivery
- Long-lasting pain relief
- Reduced chances of side effects
- Better comfort for patient

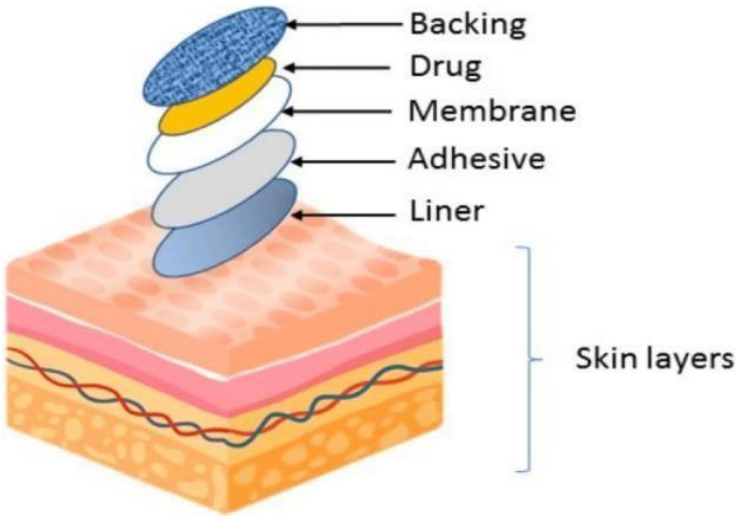

Fig. Visualization of layer of Patch

Literature Review

A Researchers have shown increasing interest in transdermal delivery of etoricoxib because oral NSAIDs often cause stomach irritation and undergo strong first-pass metabolism. Delivering etoricoxib through the skin can provide long-lasting pain relief, reduce side effects, and improve comfort for patients who need chronic treatment. Over the years, different scientists have tried a variety of methods to make etoricoxib patches more effective

1. Ahmed et al. (2026) reported drying patches at around 40°C to ensure complete solvent evaporation and formation of smooth, flexible films.

2. Lamiaa M. Ahmed et al. (2026): prepared Etoricoxib nanocrystal-loaded patches using solvent evaporation, where polymers were dissolved, followed by drug incorporation and casting into petri dishes

3. Ahmed et al. (2026): propylene glycol was used as both plasticizer and permeation enhancer, improving flexibility and drug permeation.

4. Dibya Lochan Mohanty et al. (2025) confirmed through FTIR and DSC studies that Etoricoxib remains stable when incorporated into delivery systems.

5. Khan and Bano, et al. (2025): who incorporated mesoporous silica nanoparticles into gels. Their high surface area allowed more drug to be loaded, resulting in better skin deposition and extended release.

6. Sajid Raza et al. (2025): used thiolated chitosan polymers to enhance skin permeation and drug delivery efficiency.

METHODOLOGY

1. Chemicals&Reagents

S.NO.	INGRIDIENTS	FUNCTION	QUANTITY	
1	Etoricoxib	API	20%	of polymer
2	Hydroxypropyl Methylcellulose(HPMC)	(hydrophilic filmforming)	1-2g	
3	Propyleneglycol	Plastisizer	20-30%	of polymer
4	DMSO	Permeation enhancer	5-10%	of polymer
5	ethanol	Solvent	Enough	to dissolve polymer (50-100ml)
6	Aluminiumfoil/Polymer laminates	Backing layer	Asrequired	
7	Releaseliner	Protective removable layer	Asrequired	

1.Pre formulation study:

The formulation process begins with preformulation studies of Etoricoxib to determine its physicochemical properties such as solubility, melting point, and partition coefficient. Compatibility between the drug and selected excipients is evaluated using techniques like FTIR or DSC to ensure no interaction occurs that could affect stability or efficacy.

2.Selection of excipients:

Suitable polymers such as HPMC, ethyl cellulose, or Eudragit are selected to form the matrix of the patch. A plasticizer like polyethylene glycol (PEG 400) or propylene glycol is chosen to improve flexibility, while permeation enhancers such as oleic acid or DMSO are included to facilitate drug penetration through the skin .A volatile solvent system like ethanol or methanol is selected for dissolving all components.

3.Preparation of polymericsolution:

The required quantity of polymer is accurately weighed and dissolved in an appropriate solvent or solvent mixture under continuous stirring until a clear and homogeneous solution is obtained. This forms the base matrix for the patch.

4.Incorporation of drug:

Etoricoxib is dissolved separately in a small quantity of solvent and then added slowly to the polymeric solution with constant stirring to ensure uniform distribution of the drug throughout the matrix.

5.Addition of plasticizer and permeation enhancer:

The selected plasticizer is added to the drug–polymer mixture to enhance flexibility and prevent brittleness. Subsequently, the permeation enhancer is incorporated to improve transdermal drug delivery. The mixture is stirred continuously to obtain a uniform dispersion.

6.Removal of air bubbles:

The prepared solution is allowed to stand or subjected to sonication to remove entrapped air bubbles, ensuring uniformity and preventing defects in the final patch.

7.Casting of the patch:

The bubble-freesolution is pour edintoaclean, leveledglassmoldor petri dish and spread uniformly to achieve a consistent thickness across the surface.

8.Drying process:

The casted solution is allowed to dry at room temperature or in a hot airovenmaintainedatabout40–50°Cforaspecifiedperiod,usually
24hours, to ensure complete evaporation of the solvent and formation of a solid film.

9.Backing membrane application and cutting:

After drying, the formed film is carefully removed and laminated with an impermeable backing membrane such as aluminum foil or polyethylene sheet. The patch is then cut into uniform sizes according to the required dimensions.

10.Storage of patches:

The prepared patches are wrapped in aluminum foil and stored in a desiccator to protect them from moisture and environmental factors until further evaluation.

RESULT AND DISCUSSION

Evaluation of transdermal patches-

The prepared transdermal patches were evaluated for various parameters such as:

Physical Characterization-

The physicochemical parameter such as thickness, uniformity of weight, tensile strength, content uniformity test, moisture content, moisture uptake, drug content uniformity and folding endurance of various patches were determined.

Thickness-

The thickness of the patch was determined by measuring the thickness at the random sites on the formulated patches using micrometer screw gauge and the average thickness was determined.

Uniformity of weight-

Weight variation is studied by individually weighting 10 randomly selected patches and calculating the average.

Folding endurance-

The folding endurance was measured manually for the prepared patches.Folding endurance of the film was determined by repeatedly folding a smallstrip of film (2cm×2cm) at the same place till it breaks. The number of times,the film could be folded at the same place either to break the film or to develop visible cracks, gave the evaluation of folding endurance.

Drug content-

An area of film 1cm2 was cut and dissolved in sufficient quantity of methanol. The volume was made upto 10ml. 1ml was then withdrawn from this solution and diluted to 10ml. The absorbance was then measured at 237nm.

Percentage moisture content-

The prepared patch were weighed individually and kept in a desiccators containing calcium chloride at room temperature for 24 h. The patch is weighed again after a specified interval until they show a constant weight. Thepercentage moisture content is calculated using following formula

%Moisturecontent=InitialWeight-FinalWeight×100 Final Weight

In-vitro dissolution study-

The release rate determination is one of the most important studies to be conducted for all controlled release delivery system. The dissolution studies of patches are very important because one needed to maintain the drug concentration on the surface of stratum corrneum consistently and substantially greater than the drug concentration in body to achieve a constant rate. The dissolution of patches was performed using USP basket type dissolution apparatus. The patches were placed in basket with their drug matrix exposed to phosphate buffer 7.4 all dissolution studies were performed at 37±0.5º C at 50 rpm with each dissolution jar carrying 900ml of buffer.

RESULT

The transdermal patches were prepared by solvent evaporation method and the prepared transdermal patches were evaluated for their physicochemical characteristic such as appearance, weight variation,thickness, foldingendurance, drug content moisture uptake and in vitro drugrelease study.

S.No	Formulations	Appearance	Thickness (mm)	Drug Content %	Folding endurance	Weight Variation (mg/2cm2)	%Moisture content
1	F1	Thin, opaque and flexible	0.29+0.01	97.32	<150	0.030+0.009	4.12+0.015
2	F2	Thin,transparentandnot flexible	0.25+0.01	99.10	<150	0.050+0.005	3.94+0.057

4.2 Solubility:

Solubility of drug was checked by dissolving them in different solvents. Solubility is the property of a solid, liquid or gaseous chemical substance called solute to dissolve in a solid, liquid or gaseous solvent to form a homogeneous solution of the solute in the solvent. The drug was qualitative tested for its solubility in various solvents. It was determined by shaking 10mg of drug in different solvents in test tube for several hrsasper Indian Pharmacopoeia 2010. The results obtained by solubility testing are given inthe table, in which the notation was given as per the Indian pharmacopoeia 2010.

S.NO.	SOLVENT	ETORICOXIB
1	Water	Practicallyinsoluble
2	Methanol	Freelysoluble
3	Chloroform	Freelysoluble
4	Ethanol	Soluble
5	NaOH	Insoluble
6	Sulphuricacid	Insoluble

DISCUSSION

Transdermal drug delivery system is a most suitable system for a long term treatment or for a multi dose treatment because transdermal patches are prepared for a long period of time in a single dose providing treatment from a day to even up to seven days.

TDDS also increase the bioavailability of drug by avoiding the first pass metabolism and increase the therapeutic efficacy of drug by reaching into the systemic solution. Polymers Hydroxy propyl methyl cellulose (HPMC) was selected on the basis of their adhering property and non toxicity.

The result of the finding showed excellent property and controlled release. Result from present study concluded that etoricoxib with Hydroxy propyl methyl cellulose (HPMC), Ethyl cellulose (EC) and with incorporation of poly ethylene glycol (PEG-4000) produce smooth, and transparent film. The prepared transdermal patches were evaluated for their physicochemical characteristic such as appearance, weight variation, thickness, folding endurance, drug content, and in vitro drug release study. The physical appearance of the various formulations in terms of their transparency, smoothness, flexibility, stickinessand opaque properties were recorded.

Appearance- The formulation F1 was found to be thin, opaque, and flexible, formulation F2 was found to be thin, transparent, not flexible,. The weight variation of the formulation 1 was found to be 0.030±0.005 mg/2cm2. Formulation F2 was found to be 0.057±0.009 mg/2cm2. So this formulation was rejected because in this formulation the weight variation was observed veryhigh. 97.32%, 99.10%, 97.65%, 96.23% and 98.20% forF1,F2,respectivelyFoldingendurance-The folding endurance was found to be for formulation F1= <`150, formulation F2= <150, withstand d rupture. It was found to be satisfactory. The result indicated that the patches would not break and would maintain their integrity with general skin folding when used.

The moisture content in the patches ranged from 4.24±0.015% to 3.24±0.017.The lower moisture content in the formulations helps them to remain stable and become a completely dried and brittle film and also prevents the material from bacterial growth.

CONCLUSION

Transdermal patch is a medicated adhesive patch that is placed on the skin to deliver a specific dose of medication through the skin and into the bloodstream. The study successfully developed a transdermal drug delivery system for etoricoxib to overcome limitations associated with oral administration, such as first-pass metabolism and frequent dosing. Various formulations were prepared using different polymers, plasticizers, and penetration enhancers. Among them, hydroxy propyl methyl cellulose (hpmc) showed better drug permeation compared to ethyl cellulose. The prepared patches exhibited satisfactory physical properties, including uniform thickness, smooth surface, flexibility, and good folding endurance. Drug content was uniform, and moisture studies indicated adequate stability under normal conditions. In-vitro drug release and skin permeation studies confirmed a sustained and controlled release pattern, ensuring effective drug delivery through the skin. Stability studies conducted as per ich guidelines showed no significant changes in

drug content, appearance, or release profile over time. Overall, the optimized transdermal patch enhances bioavailability, reduces dosing frequency, and improves patient compliance in long-term osteoarthritis management

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