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Review on Mefenamic Acid Transdermal Patches

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Abstract: *Primary dysmenorrhea is a menstrual problem. It happens when the uterus cramps a lot during periods. This pain comes from much prostaglandin being made in the body. Mefenamic acid is a drug used to ease pain. It is a nonsteroidal -inflammatory drug or NSAID When taken by mouth it can upset the stomach and cause other side effects A better way might be to deliver the drug through the skin. This is called delivery. One way to do this is with matrix-type patches. These patches use materials like HPMC, PVP and ethyl cellulose. They also include things that help the drug pass through the skin like menthol and peppermint oil. This review talks about how to make these patches how to test them what's good about them what problems they have and what could come next. The focus is, on acid transdermal patches.*

Keywords: Mefenamic acid, dysmenorrhea, Transdermal patch, Menthol, Polymers, Solvent casting

I. INTRODUCTION

Transdermal drug delivery systems (TDDS) are designed to deliver drugs through the skin into systemic circulation. They offer potential advantages such as sustained drug release , improved convenience , and avoidance of gastrointestinal absorption. Mefenamic acid is an NSAID used to treat menstrual pain. However , oral administration may cause gastrointestinal side effects. Therefore , developing a mefenamic acid transdermal patch is being investigated as an alternative drug delivery approach.

Primary Dysmenorrhea

Primary dysmenorrhea refers to painful menstruation without any underlying pelvic disease. It commonly affects adolescent girls and women of reproductive age. The main cause is increased prostaglandin production, which leads to excessive uterine contractions , reduced blood flow , and pain .Typical symptoms are cramps , in the belly back pain, nausea, headache and tiredness. NSAIDs, mefenamic acid are often taken to stop prostaglandin production and ease the pain.

Mefenamic Acid

Mefenamic Acid is a nonsteroidal -inflammatory medicine that is part of the fenamate group. Mefenamic Acid has pain-killing inflammation-soothing and fever-reducing effects. Mefenamic Acid works by stopping the enzymes called cyclooxygenase and by reducing the production of prostaglandins.

Need for Transdermal Drug Delivery

Oral mefenamic acid may cause gastrointestinal irritation, nausea, and abdominal discomfort. Transdermal delivery is investigated to avoid direct gastrointestinal exposure and potentially provide sustained drug administration. It may also improve patient convenience. However, sufficient skin permeation is necessary to achieve a therapeutic effect, and systemic NSAID risks may still occur.

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Transdermal Drug Delivery System

A transdermal drug delivery system is a medicated formulation designed to deliver drugs across the skin. Drug molecules are released from the patch, penetrate the stratum corneum, and diffuse through the skin toward systemic circulation. Drug delivery depends on molecular weight, solubility, lipophilicity, drug concentration, and skin permeability.

Advantages

Transdermal patches may provide sustained drug release, avoid gastrointestinal absorption, reduce administration frequency, and improve patient convenience.

Limitations

Major limitations include poor skin permeability, irritation, limited drug-loading capacity, variable absorption, and difficulties maintaining patch adhesion.

Skin as a Barrier to Drug Delivery

The skin is the organ of the body and acts as a protective barrier against external substances. It also controls the movement of drugs into the body. The stratum corneum is the barrier to transdermal drug permeation.

Structure of Skin

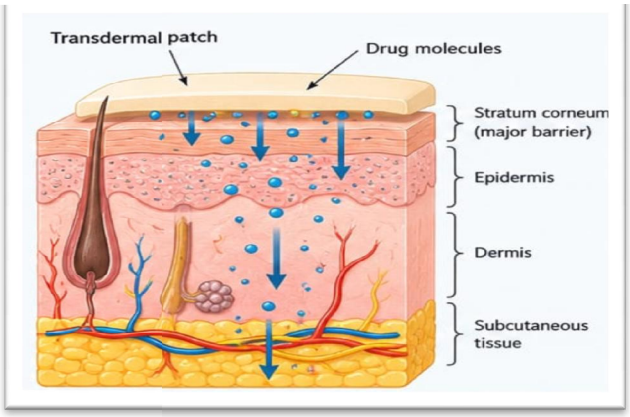


Fig. STRUCTURE OF HUMAN AND ROUTE OF DRUG PERMEATION

The skin consists of three layers:
Epidermis
Dermis
Subcutaneous Layer

1. Epidermis

The layer of the skin. It contains layers of cells with the stratum corneum being the outermost part. It provides the barrier to drug penetration.

2. Dermis

The layer below the epidermis. It contains blood vessels, nerves, hair follicles and glands. Drugs that pass through the epidermis can enter the blood circulation.

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3. Subcutaneous Layer

The layer, mainly composed of fatty tissue and connective tissue. It provides insulation, cushioning and energy storage.

Stratum Corneum

The layer of the epidermis composed mainly of dead keratinized cells surrounded by lipids. It is the barrier controlling drug permeation through the skin.

Routes of Drug Penetration

Drugs can cross the skin through:
Transcellular route – through the skin cells.
Intercellular route – between the skin cells.
Appendageal route –, through hair follicles and sweat glands.

Factors Affecting Skin Permeation

Molecular size of drug
Drug lipophilicity
Drug concentration
Skin hydration
Skin thickness
Temperature
Polymer composition
Permeation enhancer
Contact time
Condition of the skin

Natural Permeation Enhancers

Menthol

Menthol is a natural monoterpene alcohol that is commonly extracted from mint oils. I have seen how menthol may enhance drug permeation by altering the lipid arrangement of the stratum corneum. Menthol is studied in formulations to improve drug transport.

Peppermint Oil

Peppermint oil comes from Mentha × piperita. Contains components such, as menthol and menthone. I have observed that these compounds may affect stratum corneum lipids and improve drug penetration. Peppermint oil must be used at a concentration that reduces irritation and keeps the formulation stable.

Types of Transdermal Patches

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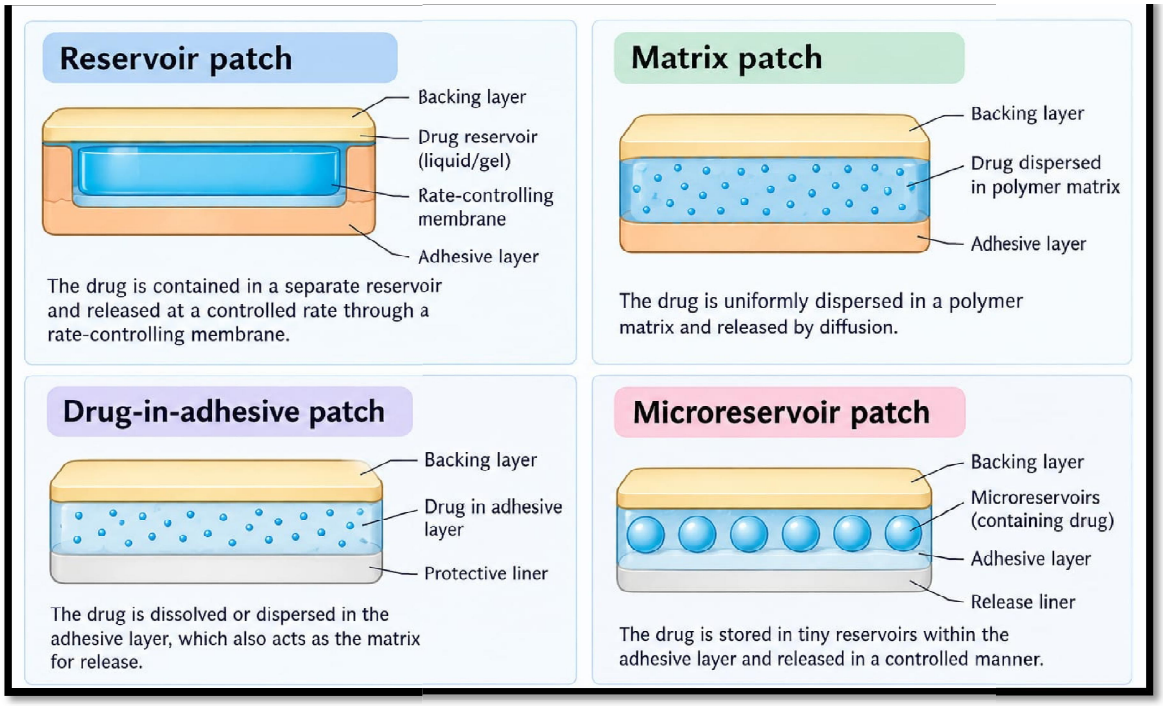


Fig. TYPES OF TRANSDERMAL PATCHES

Reservoir-type patch : The medicine is kept in a reservoir and the release is controlled by a membrane.
Matrix-type patch : The medicine is spread out. Mixed in a polymer matrix, which manages how it comes out.
Drug-in-adhesive patch : The medicine is added directly into a layer.
Microreservoir patch : The medicine is placed as reservoirs, inside a polymer matrix.

Components of Transdermal Patches

Drug: Mefenamic acid provides analgesic and anti-inflammatory activity.
Polymers: HPMC, PVP, PVA, and ethyl cellulose form the film and influence drug release.
Plasticizers: Glycerol and polyethylene glycol improve film flexibility and reduce brittleness.
Permeation enhancers: Menthol, peppermint oil, and certain other substances may improve drug penetration through the skin.
Backing membrane: Protects the patch from the external environment.
Release liner: Covers the adhesive surface and is removed before application.
Adhesive: Maintains contact between the patch and skin.

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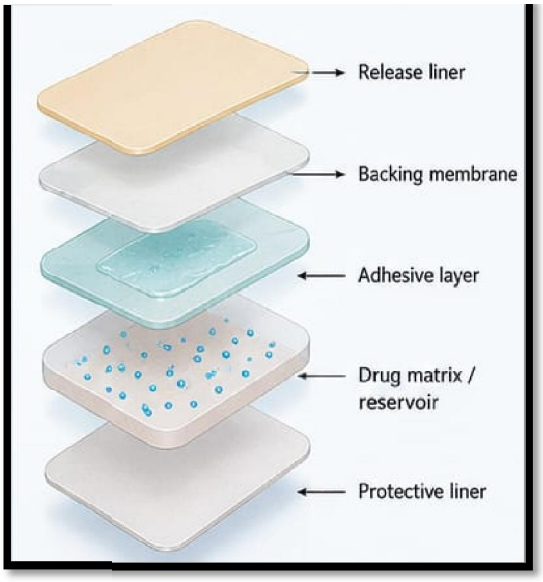


Fig. COMPONANT OF TRANSDERMAL PATCHES

Natural Permeation Enhancers

Menthol

Menthol is a natural monoterpene alcohol that comes from mint oils. Menthol can change how the lipids are arranged in the skin layer called the stratum corneum. Because of this Menthol may help drugs move through the skin. Researchers are looking at using Menthol in creams to boost drug delivery.

Peppermint Oil

Peppermint oil comes from Mentha piperita. Contains menthol and menthon . These compounds can change stratum corneum lipids and help drugs get through the skin. But the amount of Peppermint Oil must be just right so it does not irritate the skin. The product stays stable.

Preparation of Transdermal Patches by Solvent Casting Method

1. Weighing of Ingredients

Weigh the drug the polymers, the plasticizer, the permeation enhancer and the solvent according to the formulation.

↓

2. Preparation of Drug Solution

Dissolve the drug in a solvent for example ethanol with constant stirring.

↓

3. Preparation of Polymer Solution

Dissolve the polymers in a solvent and add the plasticizer and the permeation enhancer.

↓

4. Mixing

Mix the drug solution and the polymer solution and stir until a uniform bubble-free casting solution is made

↓

5. Casting

Pour the solution that is prepared onto a flat Petri plate or glass casting surface.

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↓

6. Drying

Let the solvent disappear under the temperature and time conditions until a even film is formed

↓

7. Patch Removal

Take off the dried film carefully from the casting surface.

↓

8. Cutting

Cut the film into patches that have the needed size and shape.

↓

9. Packaging

Put a release liner if needed and pack in material that stops moisture and protects from light.

↓

10. Final Product

Transdermal patches that are made and ready, for testing.

Evaluation of Transdermal Patches

Physical Appearance

Patches are visually examined for color, transparency, smoothness, flexibility, cracks, and air bubbles.

Thickness

Thickness is measured at different positions using a micrometer or vernier caliper to determine film uniformity.

Weight Variation

Patches of equal area are weighed individually, and their average weight and variation are calculated.

Folding Endurance

The film is repeatedly folded at the same position until it breaks. The number of folds indicates film flexibility.

Tensile Strength

Tensile strength determines the mechanical resistance of a film against breaking under applied force.

Tensile strength = Breaking force / Cross-sectional area

Percentage Elongation

Percentage elongation measures the stretching ability of a film before breaking.

% Elongation = (Final length − Initial length) / Initial length × 100

Drug Content

A known area of the patch is extracted using a suitable solvent, and drug concentration is determined using a validated analytical method.

Drug content (%) = (Actual drug content / Theoretical drug content) × 100

Moisture Content

Moisture content determines the amount of moisture present in the film after drying.

% Moisture content = (Initial weight − Dry weight) / Initial weight × 100

Moisture Uptake

Moisture uptake determines the ability of the film to absorb moisture under controlled humidity.

% Moisture uptake = (Final weight − Initial dry weight) / Initial dry weight × 100

Flatness

Flatness is evaluated by measuring dimensional changes in film strips. A film showing no contraction is considered to have 100% flatness.

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Surface pH

The film surface is moistened, and its apparent pH is measured using a suitable electrode to assess potential skin compatibility.

In-Vitro Drug Release

Drug release is studied using a suitable dissolution or diffusion apparatus. Samples are collected at predetermined intervals and analyzed to determine cumulative drug release.

Ex-Vivo Skin Permeation

Skin permeation is evaluated using a Franz diffusion cell with a suitable skin membrane. Drug transport is determined by measuring the amount of drug reaching the receptor compartment over time.

Skin Irritation

Skin irritation studies assess local reactions such as redness and swelling using validated methods and appropriate ethical approval.

Stability Studies

Patches are stored under selected conditions and evaluated for changes in appearance, drug content, mechanical properties, and drug release.

Challenges and Research Gap

The major challenges in developing mefenamic acid transdermal patches include poor aqueous solubility, limited skin permeability, possible drug crystallization, and formulation instability. Natural penetration enhancers such as menthol and peppermint oil may improve drug transport, but their effectiveness and safety require experimental confirmation. Further studies are necessary to optimize polymer composition, enhancer concentration, drug loading, and skin permeation.

Future Scope

Future research may focus on developing optimized matrix-type patches with improved drug solubility, sustained release, and enhanced skin permeation. Advanced formulation techniques and suitable natural enhancers may help improve drug delivery. Further pharmacokinetic, safety, and clinical studies are required to establish therapeutic effectiveness.

II. CONCLUSION

Mefenamic acid transdermal patches represent a potential alternative drug delivery approach for the management of primary dysmenorrhea. Matrix-type patches prepared using suitable polymers and penetration enhancers may provide convenient and sustained drug administration. However, successful development requires adequate drug release, skin permeation, stability, and safety. Further research is necessary to establish their clinical usefulness.

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