JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A Review on TRANSDERMAL PATCH

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Abstract:

Transdermal patches are now widely used as cosmetic, topical and transdermal delivery systems. These patches represent a key outcome from the growth in skin science, technology and expertise developed through trial, error, clinical observation and evidence-based studies, this review begins with the earliest topical therapies and traces topical delivery to the present day transdermal patches, describing along the way the devices and drug delivery systems that underpin current transdermal patches and their activities of TDDS provides a means to sustain drug release as well as reduce the intensity of action and thus reduce the,side effects associated with its oral therapy. Transdermal drugs are selfdiscrete dosage form. Transdermal Drug Delivery system in which the delivery of the active ingredients of the drug occurs by the means of skin. Skin is an effective medium from w hich absorption of the drug takes place and enter the circulatory system. Transdermal drug delivery system was introduced to overcome the difficulties of drug delivery through oral route. A transdermal patch is medicated adhesive patch that is placed on the skin to deliver a specific dose of medication through the skin and into the bloodstream. Often, this promotes healing to an injured area of the body. An advantage of a transdermal drug delivery route over other types of medication delivery such as oral, topical, intravenous, intramuscular, etc. is that the patch provides a controlled release of the medication into the patient, usually through either a porous membrane covering a reservoir of medication or through body heat melting thin layers of medication embedded in the adhesive.

Keywords: Transdermal patch, type, factors, permeation enhancers, tests

Introduction:

Transdermal patch is used to deliver a specific dose of medication through the skin and into bloodstream. Transdermal patches products were first approved in 1981 by FDA. Transdermal delivery systems are currently available containing scopolamine (hyoscine) for motion sickness, clonidine and nitroglycerin for cardiovascular disease, fentanyl for chronic pain, nicotine to aid smoking cessation. Transdermal delivery provides controlled, constant administration of the drug, and allows continuous input of drugs with short biological half-lives and eliminates pulsed entry into systemic circulation [4]

The skin is the largest organ in the human body by mass, with an area of between 1.5 and 2.0 m 2 in adults. Drugs have been applied to the skin to treat superficial disorders, for the transdermal administration of therapeutics to manage systemic ailments and as cosmetics, dating back to the oldest existing medical records of man. For instance, the use of salves, ointments, potions and even patches, consisting of plant, animal or mineral extracts was already popular in ancient Egypt and in Babylonian medicine (around 3000 BC) (Magner, 2005; Geller, 2010). However, the routine use of transdermal delivery systems only became common practice in the latter third of the 20th century [1]

Transdermal drug delivery system (TDDS) has been an increased interest in the drug administration via the skin for both local therapeutic effects on diseased skin (topical delivery) as well as for systemic delivery of drugs. The skin as a site of drug delivery has a number of significant advantages over many other routes of drug administration, including the ability to avoid problems of gastric irritation, pH and emptying rate effects, avoid hepatic first-pass metabolism thereby increasing the bioavailability of drug, reduce the risk of systemic side effects by minimizing plasma concentrations compared to oral therapy, provide a sustained release of drug at the site of application; rapid termination of therapy by removal of the device or formulation, the reduction of fluctuations in plasma levels of drugs, and avoid pain associated with injections. The transdermal delivery can also eliminate pulsed entry into the systemic circulation, which might often cause undesirable side effect [5]

Drugs are normally applied on the skin either for the treatment of systemic pathologies or localized diseases in an attempt to limit blood levels of the active ingredient. In the last decades, bio adhesive dosage forms, the patches, have been gaining an increasing interest as an alternative to semisolid dosage forms due to the possibility of prolonging the drug release over a period of time up to 7 days and predetermining the administered dose and the area of application. As differences exist in therapeutic goals pursued administering a drug onto the skin, three different monographs are reported in the European Pharmacopoeia (Ph. Eur.). The ‘Transdermal patches’ monograph, refers to drug delivery systems intended to be applied to the unbroken skin in order to deliver the active substance(s) to the systemic circulation after passing through the skin barrier. In the other two monographs, patches are reported to maintain the active substance(s) in close contact with the skin such that these may be absorbed slowly, in order to guarantee a regional effect, or act as protective or keratolytic agents (medicated plasters) or to administer a drug to skin such that it may act locally (cutaneous patches) [6]

Transdermal patches are innovative drug delivery systems intended for skin application to achieve a systemic effect. Among the different types of systems, the drug-in-adhesive products, in which the drug is included in the adhesive layer contacting the skin, are very commonly used, being thin and comfortable to wear. More and more efficient systems have been introduced into the market, with the advantage of reducing the size of the patch to that of a postage stamp (Dot-Matrix®, Novozymes Pharmaceuticals). Such a system offers a variety of significant clinical benefits over other systems, such as tablets and injections. For example, it provides controlled release of the drug, and produces a steady blood-level profile, leading to reduced systemic side effects and, sometimes, improved efficacy over other dosage forms (Ranade, 1991; Modamio et al., 2000; Ke et al., 2005). In addition, the transdermal patch dosage form is user-friendly, convenient, painless, and offers multi-day dosing, it generally leads to improved patient compliance (Audet et al., 2001). Consequently, the transdermal therapeutic system is of particular clinical significance for the prevention and long-term treatment of chronic diseases like hypertension.[8]

Development of a safe and efficient drug delivery system is the aim of every pharmaceutical researcher and industry, Transdermal route of drug delivery can achieve local and systemic therapeutic effects Transdermal drug delivery is an attractive substitute for oral drug administration as it bypasses first pass metabolism, gastrointestinal effects and, moreover, it can overcome the poor patient compliance associated with other drug delivery routes, Transdermal drug delivery is self-administered, allowing the drug to pass through intact skin over a controlled period of time to achieve a local or systemic effect . Drugs can be delivered through transdermal patches in dissolved lipid-based form enabling them to produce the required efficacy The first transdermal system containing scopolamine was approved in the United States in 1979; the US Food and Drug Administration (FDA) approved nicotine patches in 1984. A decade later, transdermal patches for pain relief, analgesic activity, contraception, and hormone replacement therapy were FDA approved and marketed [9]

Some drugs must be combined with substances, such as alcohol, that increase their ability to penetrate the skin in order to be used in a skin patch. Drugs administered through skin patches include scopolamine (for motion sickness), nicotine (for quitting smoking), estrogen (for menopause and to prevent osteoporosis after menopause), nitroglycerin (for angina), and lidocaine to relieve the pain of shingles (herpes zoster). Patches applied to the skin eliminate the need for vascular access by syringe or the use of pumps. Transdermal patches were developed in the 1970s and the first was approved by the FDA in 1979 for the treatment of motion sickness.[11]

Transdermal drug delivery systems evade a variety of issues associated with other routes of drug administration, such as first-pass hepatic metabolism, enzymatic digestion, drug hydrolysis in acidic environments, gastrointestinal irritation, drug fluctuations, adverse effects and therapeutic failure, and disease transmission risk. Further advantages include patient compliance, low cost, and controlled drug release [9]

Classification of transdermal drug delivery systems has proceeded through three generations on the basis of drug molecule size and the presence of penetration enhancer materials, In the first generation, small drug molecules

could be topically applied without using transdermal penetration enhancing agents. In the second generation, transdermal enhancing agents were added to enhance the penetration of topically applied small drug molecules [9

Transdermal patch:

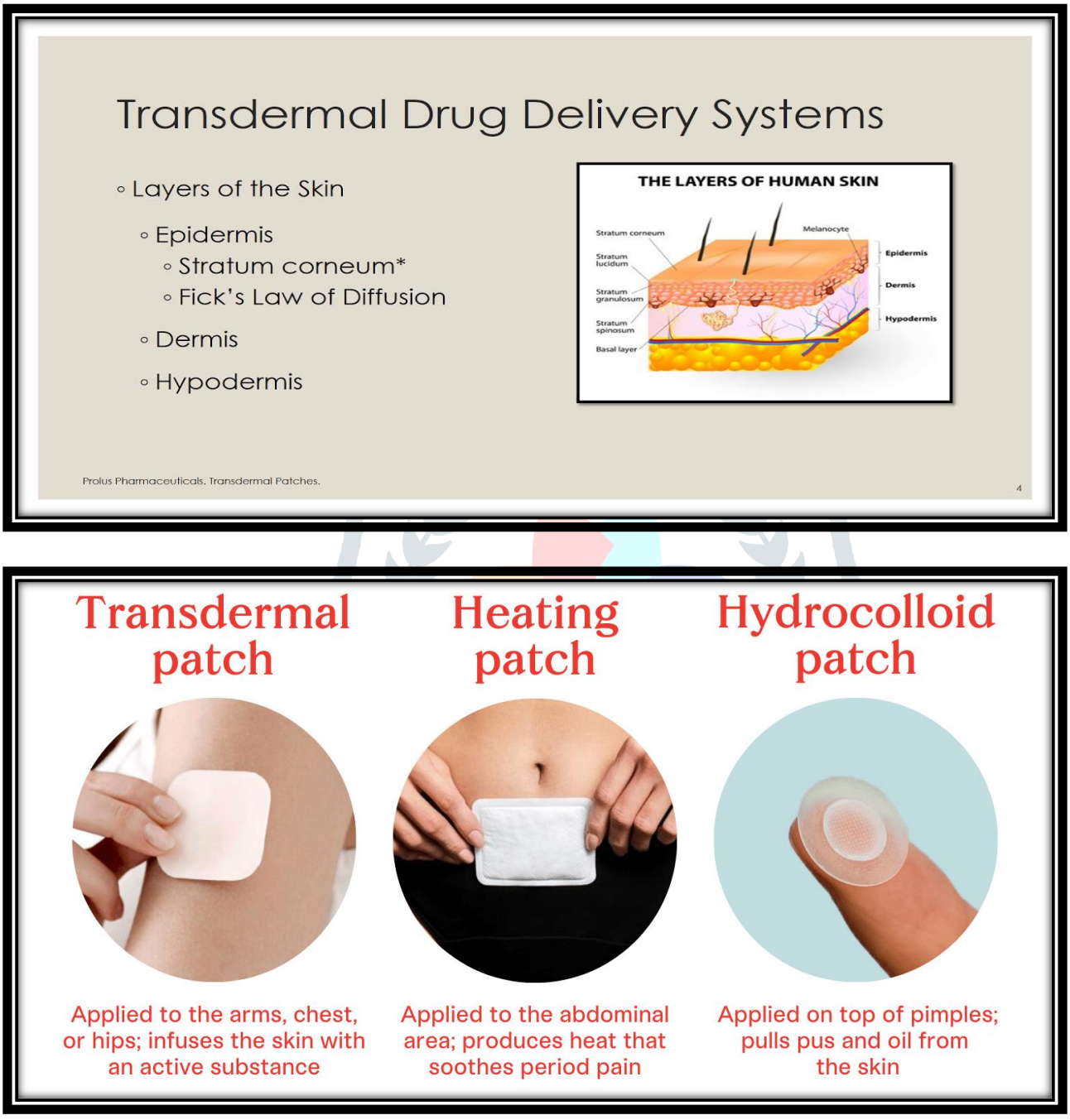

Fig TDDS and different types of patches [14,15]

BASIC COMPONENTS OF TDDS patch

1. Polymer matrix / Drug reservoir
2. Drug
3. Permeation enhancers
4. Pressure sensitive adhesive (PSA)
5. Backing laminates
6. Release liner
7. Other excipients like plasticizers and solvents

1. **Polymer matrix:**

Polymers are the backbone of a transdermal drug delivery system. Systems for transdermal delivery are fabricated as multilayered polymeric laminates in which a drug reservoir or a drug–polymer matrix is sandwiched between two polymeric layers: an outer impervious backing layer that prevents the loss of drug through the backing surface and an inner polymeric layer that functions as an adhesive and/or rate-controlling membrane. Polymer selection and design must be considered when striving to meet the diverse criteria for the fabrication of effective transdermal delivery systems.

The main challenge is in the design of a polymer matrix, followed by optimization of the drug loaded matrix not only in terms of release properties, but also with respect to its adhesion– cohesion balance, physicochemical properties, and compatibility and stability with other componentsnof the system as well as with skin. The polymers utilized for TDDS can be classified as

• Natural Polymers: e.g. cellulose derivatives, zein, gelatin, shellac, waxes, gums, natural rubber and chitosan etc.

• Synthetic Elastomers: e.g. polybutadiene, hydrin rubber, polyisobutylene, silicon rubber, nitrile, acrylonitrile, neoprene, butyl rubber etc.

2. **Drug:**

The most important criteria for TDDS are that the drug possesses the right physicochemical and pharmacokinetic properties. Transdermal patches offer much to drugs which undergo extensive first pass metabolism, drugs with narrow therapeutic window, or drugs with short half life which causes non- compliance due to frequent dosing. For example, drugs like rivastigmine for Alzheimer's and Parkinson dementia, rotigotine for Parkinson, methylphenidate for attention deficit hyperactive disorder and selegiline for depression are recently approved as TDDS.

3. **Permeation enhancers:**

   It increases permeability of stratum corneum so as to attain higher therapeutic levels of the drug penetration enhancers interact with structural components of stratum corneum i.e., proteins or lipids. The enhancement in absorption of oil soluble drugs is apparently due to the partial leaching of the epidermal lipids by the chemical enhancers, resulting in the improvement of the skin conditions for wetting and for trans epidermal and trans follicular penetration. The miscibility and solution properties of the enhancers used could be responsible for the enhanced transdermal permeation of water- soluble drugs. Pharmaceutical scientists have made great efforts in transdermal permeation studies using various enhancers for several drug moieties.

Classification of penetration enhancers

- **Terpen essential oils**: E.g., Nerolidol, menthol, cineol, limonene, carvone etc.
- **Pyrrolidone's**: E.g., N-methyl-pyrrolidone (NMP), ozone etc.
- **Fatty acids and esters**: E.g., Oleic acid, linoleic acid, lauric acid, capric acid etc.
- **Sulfoxides and similar compounds**: E.g., Dimethyl sulfoxide DMSO, N, Ndimethyl formamide
- **Alcohols, Glycols, and Glycerides**: E.g., Ethanol, Propylene glycol, Octyl alcohol etc.
- **Miscellaneous. enhancers**: E.g., Phospholipids, Cyclodextrins, Amino acid derivatives, Enzymes etc. [3]

4. **Pressure sensitive adhesive**

   A PSA maintains an intimate contact between patch and the skin surface.) t should adhere with not more than applied finger pressure, be aggressively and permanently tachy, exert a strong holding force. For egg polyacrylates, polyisobutylene and silicon-based adhesives. The selection of an adhesive is based on numerous factors, including the patch design and drug formulation. PSA should be physicochemically and biologically compatible and should not alter drug release. The PSA can be positioned on the face of the device as in reservoir system or in the back of the device and extending peripherally as in case of matrix system

5. **Backin-laminate:**

   The primary function of the backing laminate is to provide support. Backing layer should be chemical resistant and excipient compatible because the prolonged contact between the backing layer and the excipients may cause the additives to leach out or may lead to diffusion of excipients, drug or penetration enhancer through the layer

6. **Release liner:**

During storage release liner prevents the loss of the drug that has migrated into the adhesive layer and contamination.) it is therefore regarded as a part of the primary packaging material rather than a part of dosage form for delivering the drug. The release liner is composed of a base layer which may be non-occlusive e.g. paper fabric or occlusive e.g., polyethylene, polyvinylchloride and a release coating layer made up of silicon or Teflon. [3]

7. **Other materials used**

Meant for TDDS release liner include polyester foil and metallized laminate. Other excipients Various solvents such as chloroform, methanol, acetone, isopropanol and dichloromethane are used to prepare drug reservoir.) n addition plasticizers such as butylphthalide, triethyl citrate, polyethylene glycol and propylene glycol are added to provide plasticity to the transdermal patch.

Drug	**Product name**	**Clinical use**
Scopolamine	Transderm-Scop	Motion sickness
Nitroglycerin	Transderm-Nitro	Angina pectoris
Clonidine	Catapres-TTS	High blood pressure
Estradiol	Estraderm	Menopause
Fentanyl	Duragesic	Chronic pain
Nicotine	Nicoderm	Smoking cessation
Testosterone	Testoderm	Testosterone low level
Lidocaine/epinephrine	Iontocaine	Pain relief
Estradiol/norethidrone	Combipatch	Menopause
Lidocaine	Lidoderm	Pain relief
Norelgestromin	Ortho Evra	Contraception

Table 1 Drug product and clinical use of transdermal patches on the current market [9]

BIOPHARMACEUTICAL PARAMETERS IN DRUG SELECTION FOR TRANSDERMAL PATCH

• Dose should be low i.e., less than 20 mg/day.

• half-life should be10 hr. or less.

• Molecular weight should be <400

• Partition coefficient should be Log P

(Octanol-water) between 1.0 and 4

• Skin permeability coefficient should be <0.500000cm/h.

• Drug should be non-irritating and non-sensitizing to the skin.

• Oral bioavailability should be low.

• Therapeutic index should be low.

TYPES OF TRANSDERMAL PATCHES

There are following are types of transdermal patches**:**

A. Single-layer Drug-in-Adhesive:

The adhesive layer of this system contains the drug. In this type of patch, the adhesive layer not only serves to adhere the various layers together, along with the entire system to the skin, but is also responsible for the releasing of the drug. The adhesive layer is surrounded by a temporary liner and a backing

B. The multi-layer drug:

In adhesive patch is similar to the single-layer system in that both adhesive layers are also responsible for the releasing of the drug. One of the layers is for immediate release of the drug and other layer is for control release of drug from the reservoir. The multi-layer system is different however that it adds another layer of drug-in-adhesive, usually separated by a membrane Multi-layer Drug-in-Adhesive (but not in all cases). This patch also has a temporary liner-layer and a permanent backing.

C. Micro reservoir transdermal patches:

Micro reservoir transdermal patches combine matrix dispersion with a drug reservoir. The reservoir is prepared by suspending the drug in an aqueous solution of hydrophilic polymer, then homogeneously dispersing the drug suspension on a lipophilic polymer. Dispersion is carried out with a high shear mechanical force, which results in the formation of thousands of microscopic, unbleachable spheres. The drug release profile follows a zero-order rate of kinetic drug release, maintaining a constant drug level in the plasma. Crosslinking polymeric agents are usually added, since the drug dispersion needs to be thermodynamically stable [9]

D. Matrix:

The Matrix system has a drug layer of a semisolid matrix containing a drug solution or suspension. The adhesive layer in this patch surrounds the drug layer partially overlaying it. Also known as a monolithic device. (Fig 10)

E. Vapour Patch:

In this type of patch, the adhesive layer not only serves to adhere the various layers together but also to release vapour. The vapour patches are new on the market and they release essential oils for up to 6 hours. The vapour patches release essential oils and is used in cases of decongestion mainly. Other vapour patches on the market are controller vapour patches that improve the quality of sleep. Vapour patches that reduce the quantity of cigarettes that one smokes in a month are also available on the market [4]

F. Miscellaneous transdermal patches

Other FDA approved transdermal matrix delivery systems are transdermal patches with adhesive tapes, transdermal gel, transdermal spray, iontophoretic delivery, and phonophoresis delivery, as shown in below fig 1

Advantages

1. It is convenient method and requires only once weekly application. Such a simple dosing regimen can aid in patient adherence to drug therapy.
2. Transdermal drug delivery can be used as an alternative route of administration to accommodate patients who cannot tolerate oral dosage forms.
3. It is of great advantage in patients who are nauseated or unconscious.
4. Drugs that cause gastrointestinal upset can be good candidates for transdermal delivery because this method avoids direct effects on the stomach and intestine.
5. Drugs that are degraded by the enzymes and acids in the gastrointestinal system may also be good targets. [4]
6. First pass metabolism, an additional limitation to oral drug delivery, can be avoided with transdermal administration.
7. Drugs that require relatively consistent plasma levels are very good candidates for transdermal drug delivery [4]
8. Therapeutic failures associated with irregularities in the dosing with conventional therapies can be avoided.
9. The adverse effects are minimized due to a steady and optimum blood concentration time profile.
10. The risks, pain and inconvenience associated with parenteral therapy are evaded.
11. The release is more prolonged than oral sustained drug delivery systems.
12. At times the maintenance of the drug concentration within the BioPhase is not desired; therefore, transdermal systems are suitable in this case.
13. The daily dose of the drug required is lower than that with conventional therapies.
14. The drug release is such that there is a predictable and extended duration of activity.[14]

Disadvantages

1. Possibility of local irritation at the site of application.
2. Erythema, itching, and local edema can be caused by the drug, the adhesive, or other excipients in the patch formulation.
3. May cause allergic reactions.
4. A molecular weight less than 500 Da is essential.
5. Sufficient aqueous and lipid solubility, a log P (octanol/water) between 1 and 3 is required for permeate to transverse SC and underlying aqueous layers [4]
6. Transdermal therapy is feasible for certain potent drugs only
7. Transdermal therapy is not feasible for ionic drugs.
8. It cannot deliver drug in pulsatile fashion.[14]

Factors affecting transdermal drug delivery

Human skin is an efficient protective barrier. Choosing a candidate drug that is suitable for making transdermal formulations can be difficult. Several variables influence the transdermal transport and bioavailability of drugs as the drug travers's various structural layers of the skin, Preferred candidate drugs for transdermal delivery are those with low molecular weight and lipophilicity, which correlate with good solubility and penetration through the skin. In addition, drugs that are more volatile and have lower melting points tend to be more easily formulated into a transdermal patch as they permeate the skin more efficiently [Vecchia and Bunge, 2003]. There is limited availability of commonly used medications as transdermal formulations. Recent advances in methods for modulating skin penetration to enhance transdermal transport of drugs may enable a wider choice of medications available as TDs [13]

Drug	Product name	Transdermal delivery system
Flurandrenolide	Cordran® Tape	Transdermal tape
Testosterone	AndroGel®	Transdermal gel
Estradiol	Evamist®	Transdermal spray
Fentanyl HCl	IONSYS®	Iontophoretic patch
Insulin	Vyteris insulin patch®	Iontophoretical patch
Hydrocortisone	Tegaderm patch	Electrophotophoresis

Table 2 FDA approved other transdermal delivery system [9]

Adverse events:

In 2005, the FDA announced that they were investigating reports of death and other serious adverse events related to narcotic overdose in patients using Duragesic, the fentanyl transdermal patch for pain control. The Duragesic product label was subsequently updated to add safety information in June 2005. In 2008, two manufacturers of the Fentanyl patch, Alza Pharmaceuticals (a division of major medical manufacturer Johnson & Johnson) and Sandoz, subsequently issued a recall of their versions of the patch due to a manufacturing

As of 2010, Sandoz no longer uses gel in its transdermal fentanyl patch; instead, Sandoz-branded fentanyl patches use a matrix/adhesive suspension (where the medication is blended with the adhesive instead of held in a separate pouch with a porous membrane), similar to other fentanyl patch manufacturers such as Mylan and Janssen

In 2007, Shire and Noven Pharmaceuticals, manufacturers of the Daytrana ADHD patch, announced a voluntary recall of several lots of the patch due to problems with separating the patch from its protective release liner. Since then, no further problems with either the patch or its protective packaging have been reported.

In 2009, the FDA announced a public health advisory warning of the risk of burns during MRI scans from transdermal drug patches with metallic backings. Patients should be advised to remove any medicated patch prior to an MRI scan and replace it with a new patch after the scan is complete. Skin burns have occurred with metal containing transdermal patches at the time of shock therapy from external as well as internal cardioverter defibrillators (ICD)

Different aspect of transdermal patch and its imp factor and its test:[9]

- **Drug-polymer interaction studies**

  Interactions between drugs and polymers in a lipid matrix can be determined using a number of thermal and physic-analytical techniques such as differential scanning calorimetry (DSC), Fourier transform infrared spectroscopy (FTIR), X-ray powder diffractometry (XRPD), nuclear magnetic resonance (NMR) spectroscopy, and infrared (IR) radiation. Identification of components in a eutectic drug-polymer mixture is possible because each chemical has a unique peak in DSC, IR, and NMR spectra. To observe interactions between cell surface and polymer, a florescence agent is attached to the polymer, the complex is incubated with cells, and the polymer-cell complex is visualized under a confocal microscope. NMR can be used to clarify the effect of the polymer on lipid membrane fluidization/stabilization

- **Patch thickness**:

  Patch thickness is calculated by taking readings at three to five places on the patch with a digital micrometer screw gauge. Mean thickness and standard deviation of such multiple readings are determined to make sure that patch thickness is appropriate

- **Weight uniformity**

  Weight uniformity is determined by weighing 10 individual, randomly selected patches, and calculating the average weight and standard deviation. Individual patch weight must not vary to a large extent from the average weight

- **Folding endurance**

  When a particular area of patch is sliced evenly and repeatedly folded at an identical point until it breaks, folding endurance is the number of times the film is folded without breaking

- **Moisture content**

  To calculate the moisture content of a transdermal patch, the patch is accurately weighed, placed in a desiccator with fused calcium chloride for 24 h and then reweighed

  Percentage of moisture in the patch is calculated using the following equation

Moisture content (%) = Initial mass- Final mass÷ $initiaal\ mass\times 100$

- **Moisture uptake or mass gain**

  mass gain in a transdermal patch usually signifies moisture uptake. To measure moisture uptake, the patch is weighed, placed in a desiccator with a saturated KCl solution, and incubated up to 24 h with RH maintained at about 84 %. The patch is then reweighed and moisture uptake is calculated using equation (2)

- **Evaluation of water vapor permeability**

  A natural air circulation oven is used to determine water vapor permeability (WVP) in a patch, where:

  WVP = W/A

  water vapor permeability is expressed in g m–2 per 24 hr.

Where

W is amount of water vapor (g per 24 h) permeated in the patch,

A is the surface area (m2) exposed on the patch sample

- **Drug content**

To measure the drug content of a transdermal patch, a specific area of the patch is dissolved in a specific volume of a selected solvent. The solution is shaken continuously for up to 24 h, ultrasonicated for a specific period of time and then filtered. Drug content in the filtrate is determined using an appropriate analytical method.

- **Flatness test**

A transdermal patch is cut into three longitudinal strips: one from the right side, one from the left side, and one from the center. The length of each strip is measured (90). The following equation is used for flatness determination:

$$\text{Constriction (\%)} = (I1 - I2) \times 100$$

where I1 = strip initial length, I2 = strip final length.

- **Stability studies** Prepared transdermal patches are stored for six months at 40 ± 0.5 °C and RH of 75 ± 5 %. After the six-month storage, the samples are taken out of storage at intervals of 0, 30, 60, 90, and 180 days and analyzed to determine the drug content

- **Determination of adhesive properties**

  Adhesive properties can be characterized using a number of tests such as peel force tests, adhesive strength tests and tack tests. In vitro and in vivo tests can be used to characterize the adhesive properties of the drug in a transdermal preparation.

- **Tack properties**

  Tack is the ability of a given polymer to stick to a substrate when light pressure is applied. Tack depends on the composition and the molecular weight of the polymer.

- **Probe tack test**

  The force required to pull a probe, far from the adhesive polymer at a fixed rate, is measured as the value of tack. The probe tack test can be used to replace the thumb test to determine the amount of force required to break the bond of the surface of a pressure sensitive adhesive in a transdermal patch (92). The force required to break the bond over specific time is plotted as force vs. time.

- **Quick stick test/Peel tack test**

  This test involves pulling an adhesive tape over the transdermal patch at an angle of 90° and a speed of 12 inches/min. The tack value is the peeling force needed for breaking the bond between substrate and adhesive.

- **Peel adhesion test**

  Peel adhesion is the force needed to remove an adhesive polymer coating from a given substance. To measure peel adhesion, a piece of tape is applied to a plate of stainless-steel backing membrane and then pulled at 180° from the test substance. The force required to pull the tape is then measured. The test is performed to make sure that the adhesive does not damage the skin and that no residues are left on the skin.

- **Tensile strength**

  Tensile strength is measured with a tensiometer. A patch is fixed to the tensiometer assembly, the weight required to break the patch is determined, and the resultant elongation of the patch is measured (with the pointer on the instrument). The mean of three patch readings is considered to be the tensile strength of the patch.

  The tensile strength of the patch is:

$$\text{Tensile strength} = \text{break force} / a \times b\,(1 + \Delta L/L)$$

  where, a = patch width, b = patch thickness, L = patch length, ΔL = patch elongation at breakage point, and break force = weight (kg) required for patch breakage.

- **Swellability**

  To determine the swell ability of a transdermal patch, the sample is applied to a preweighed cover slip in a Petri dish containing 50 mL phosphate buffer, pH 7.4. Sample absorption takes place during time t (usually about 30 min) (95). After time t has elapsed, the cover slip is removed from the Petri dish, washed and weighed. The change in mass is equal to the mass of water absorbed by the patch.

- **Percentage swelling (S**) is determined by the following equation.

$$S\,(\%) = \frac{W_t - W_0}{W_0} \times 100$$

) Where S = % swelling,

  W0 = original mass of the patch at time zero,

  Wt. = patch mass at time t after swelling

Conclusion:

Transdermal drug delivery represents one of the most rapidly advancing areas of novel drug delivery. Due to recent advances in technology and the ability to deliver the drug systemically without rupturing the skin membrane, transdermal route is becoming a widely accepted route of drug administration. TDDS are designed for controlled release of drug through the skin into systemic circulation maintaining consistent efficacy. On the basis of the obtained review, this article provides valuable literature on transdermal patches, structural components, characterization and assessment tools required for the preparation, development transdermal drug delivery systems have been used as safe and effective drug delivery devices since 1981. A lot of progress has been done in the field of Transdermal Patches. Due to large advantages of the Transdermal Drug Delivery System, this system interests a lot of researchers. Many new researches are going on in the present day to incorporate newer drugs via this system.

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