Review Article

A brief overview on transdermal patches and marketed preparations

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Abstract
Transdermal drug delivery systems, sometimes referred to as "patches," have significantly improved patient outcomes by offering the benefit of a relatively painless method of administering medication through the skin to provide a systemic effect. Benefits of these patches include regulated medication release, convenience of usage, and avoiding first-pass metabolism. Transdermal drug delivery system was presented to overcome the difficulties of drug delivery especially oral route. A 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. It promotes healing to an injured area of the body.The review gives valuable information about the transdermal patch like its advantage, disadvantage, types of transdermal patch, factors basic components, methods, evaluation, technologies and marketed products .

Keywords: Transdermal Patch, Polymer Matrix, Adhesives, Permeation Enhancers, Controlled release, Skin, Backing Membrane.

Introduction

Oral route is the popular route of drug delivery. Although it has some disadvantages including first pass metabolism, drug degradation in gastrointestinal tract due to enzymes, PH etc. To cross these problems, a novel drug delivery system was developed. In this transdermal delivery system medicated adhesive patches are prepared which deliver therapeutically effective amount of drug across the skin when it placed on skin. Medicated adhesive patches or transdermal patches are of different sizes, having more than one ingredient. Once they apply on unbroken skin they deliver active ingredients into systemic circulation passing via skin barriers. A patch containing high dose of drug inside which is retained on the skin for prolonged period of time, which get enters into blood flow via diffusion process. Transdermal drug delivery systems are used in various skin disorders, also in the management of angina pectoris, pains, smoking cessation& neurological disorders such as Parkinson's disease.[1,2]

Transdermal drug delivery systems are defined as self-contained, discrete dosage forms which, when applied to the intact skin, deliver the drug, through the skin, at a controlled rate to the systemic circulation.Transdermal drug delivery system is systemic drug delivery system through topical application to intact skin surface which provides continues intravenous infusion of drug at programmed rate. It helps to maintain constant prolonged and therapeutically-effective drug level in the body [3] .

Topical formulations containing drugs showing systemic action are called transdermal delivery systems (TDS) or transdermal therapeutic systems. Transdermal delivery may be defined as the delivery of a drug through 'intact' skin so that it reaches the systemic circulation in sufficient quantity, to be beneficial after administration of a therapeutic dose. Transdermal systems are ideally suited for diseases that demand chronic treatment. Hence, anti-diabetic agents of both therapeutic and prophylactic usage have been subjected to transdermal investigation.

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Fig no.1: Transdermal patch

Advantages and disadvantages of transdermal Patches[3]

Advantages of transdermal Patches

- Long duration of action.
- Increase the therapeutic value of many drugs by avoiding specific problems associated with the drug e.g., gastro-intestinal irritation, low absorption, decomposition due to hepatic "first-pass" effect, formation of metabolites that cause side effects etc.
- Improved patient compliance.
- Maintenance of the constant drug concentration.
- Application and removal of transdermal patch produce the optimal sequence of pharmacological effect.
- Self-administration is possible.
- Drug action can be terminated at any point of time by removing transdermal patch.

Disadvantages of transdermal Patches

- Difficult to administer large dose.
- Skin irritation or contact dermatitis due to the drug, excipients and enhancers of the drug used to increase percutaneous absorption.
- The barrier function of the skin changes from one site to another on the same person, form person to person and with age.
- Many drugs especially drugs with hydrophilic structures permeate the skin too slowly to be of therapeutic benefit.

- Sufficient aqueous and lipid solubility, a log P (octanol/water) between 1 and 3 is required for permeate to transverse SC and underlying aqueous.
- A molecular weight less than 500 Da is essential.

Factors influencing transdermal drug delivery[4]:
The effective Transdermal drug delivery can be formulated by considering three factors as Drug, Skin, and the vehicles. So the factors affecting can be divided in two classes as biological factors and physicochemical factors are shown in table no.1

Table 1: Factors Influencing Transdermal Drug Delivery

Sr.No.	Biological factors	Physicochemical factors
1	Skin condition	Skin hydration
2	Skin age	Temperature and pH
3	Blood supply	Diffusion coefficient
4	Regional skin site	Drug concentration
5	Skin metabolism	Partition coefficient
6	Species differences	Molecular size and shape

Factors affecting permeability[5]
Factors Affecting Permeability are shown in table no.2:

Table no.2: Factors Affecting Permeability of Transdermal patches

Physiological factors:	Formulation factors	Physicochemical properties of enhancers
Anatomic site of application on the body	Physical chemistry of transport	Partition coefficient of 1 or greater is required
Skin condition and disease	Vehicles and membrane	pH value should be moderate
Age of the patient	Penetration enhancers	Concentration of penetrant higher than solubility,

Components of transdermal pathches[6]
Components of transdermal patches shown in fig no.2 and diagramically shown in fig no.3:

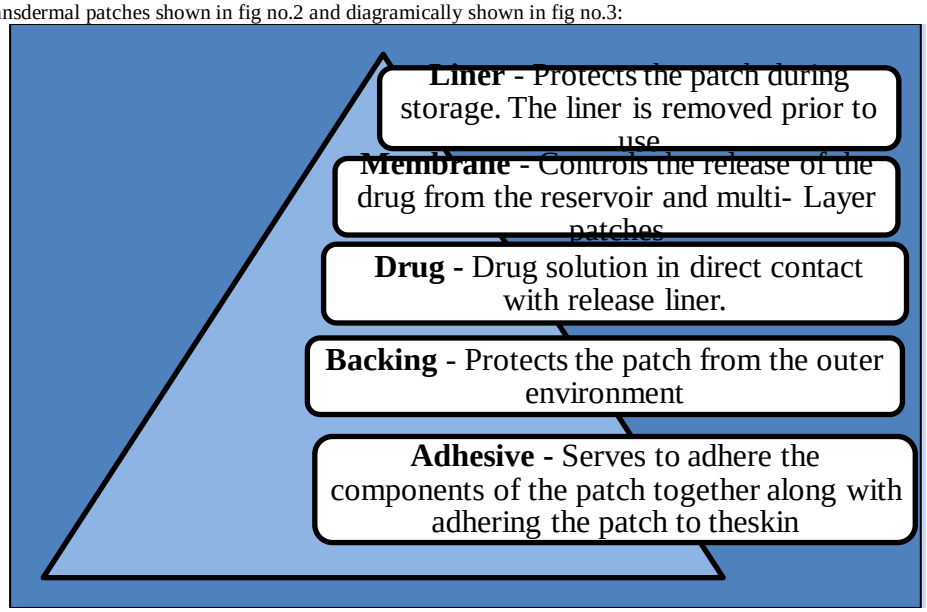

Figure 2: Flow chart components of Transdermal Pathches

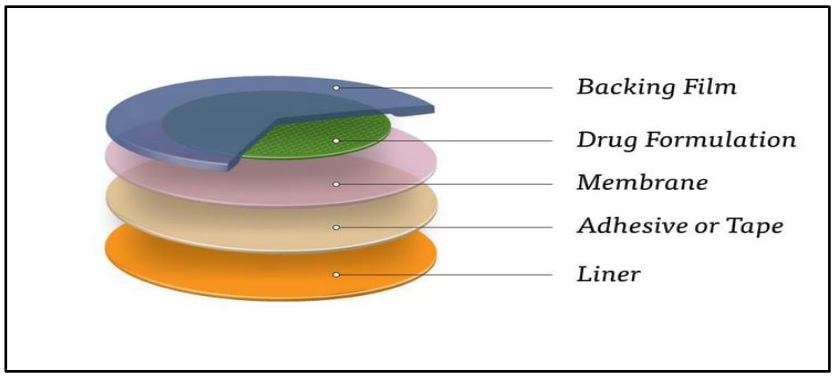

Figure no.3: Components of Transdermal Pathches

Polymer Matrix[6]
The polymer controls the release of the drug from the device. The following criteria should be satisfied for a polymer to be used in transdermal patches.
(a) Molecular weight, chemical functionality of the polymer should be specific that the drug diffuses properly and gets released through it.
(b) The polymer should be stable.
(c) The polymer should be nontoxic.
(d) The polymer should be inexpensive.

Types of Polymer: Different types of polymer are shown in table no.3

Table 3: Types of polymer

Sr.No.	Natural polymers	Synthetic Elastomers	Synthetic polymers
1	Cellulose derivative	Hydrin rubber	Polyamiode, polyurea
2	Gelatin ,Waxes	silicone rubber	polypropylene
3	Proteins	Nitrile	polyethylene
4	Gum, Natural rubber	Acrylonitrile	polyvinyl chloride
5	Shellac ,starch	Neoprene	Polyvinyl alcohol

Drug
Transdermal patches offer much 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. The drugs for Transdermal delivery in addition drugs like Rivastigmine for Alzheimer's and Parkinson dementia[7].

Permeation Enhancer: Various permeability enhancer are used in the preparation of transdermal patches which are shown in table no.4:

Table 4: Permeation Enhancer

Solvent	Surfactants	Miscellaneous Chemicals
Water alcohols–Methanol and ethanol	Anionic surfactant: Sodium lauryl sulphate Diacetyl sulphosuccinate	Urea, Phosphatide choline
Dimethyl acetemide Propylene glycol and Glycerol	Nonionic Surfactant:-Pluronic F127, Pluronic F68	Calcium thioglycolate

Pressure sensitive adhesives[8]:
A Pressure sensitive adhesives is a material that helps in maintaining an intimate contact between transdermal system and the skin surface. It should adhere with not more than applied finger pressure, be aggressively and permanently tacky, exert a strong holding force. Additionally, it should be removable from the smooth surface without leaving a residue. Polyacrylates polyisobutylene and silicon based adhesives are widely used in Todd's or dysmetropsia.

Release Liner[8]
During storage the patch is covered by a protective liner that is removed and discharged immediately before the application of the patch to skin. It is therefore regarded as a part of the primary packaging material rather than a part of dosage form for delivering the drug.

Backing laminates[8]
While designing a backing layer the consideration of chemical resistance and excipients may compatible because the prolonged contact between the backing layer and the excipients, drug or penetration enhancer through the layer. They should a low moisture vapour transmission rate. They must have optimal elasticity, flexibility and tensile strength. e.g: aluminium vapour coated layer, a plastic film and heat real layer.

Types of transdermal patches
- Single-layer Drug-in-Adhesive
- Multi-layer Drug-in-Adhesive
- Drug Reservoir-in-Adhesive
- Drug Matrix-in-Adhesive
- Vapour Patch

Single-layer Drug-in-Adhesive[9]
The adhesive layer of this system also 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.

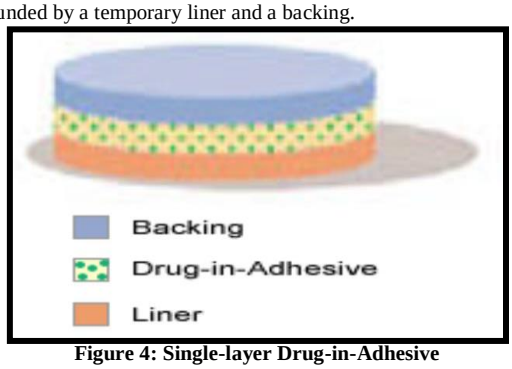

Figure 4: Single-layer Drug-in-Adhesive

Multi-layer Drug-in-Adhesive
It is similar to the single-layer system in that the drug is incorporated directly into the adhesive. The multi-layer system is different however that it adds another layer of drug in-adhesive, usually separated by a membrane (but not in all cases). This patch also has a temporary liner layer and a permanent backing.

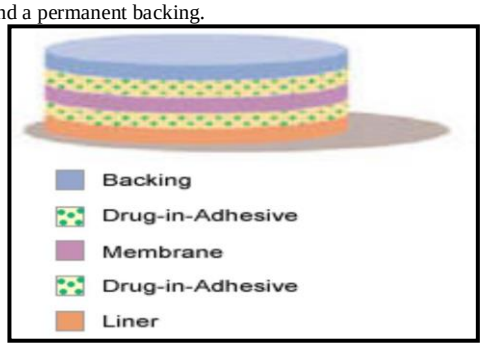

Figure 5: Multi-layer Drug-in-Adhesive

Drug Reservoir-in-Adhesive

Unlike the Single-layer and Multi-layer Drug-in adhesive systems the reservoir transdermal system has a separate drug layer. The drug layer is a liquid compartment containing a drug solution or suspension separated by the adhesive layer. This patch is also backed by the backing layer.

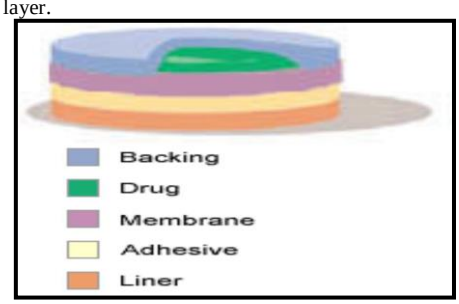

Figure 6: Drug Reservoir-in-Adhesive

Drug Matrix-in-Adhesive

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[10].

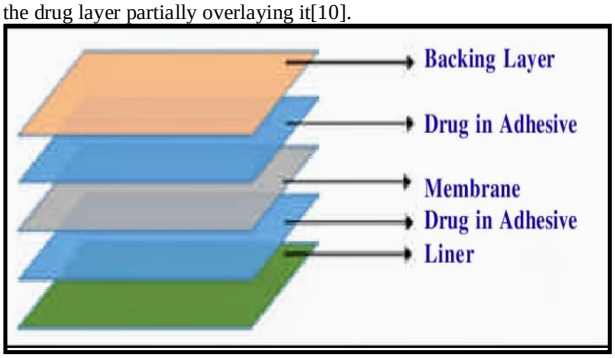

Figure 7: Drug Matrix -in-Adhesive

Vapour Patch[11]

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 are 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.

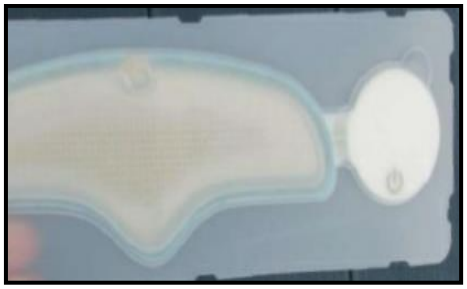

Figure no.8: Vapour patch

Desirable features for TDDS:[12,13]

- Composition relatively invariant in use.
- System size reasonable.
- Defined site for application.
- Application technique highly reproducible.
- Delivery is zero order.
- Delivery is efficient.

Conditions in which transdermal patches are to be used

- When the patient has intolerable side effects (including constipation) and who is unable to take oral medication (dysphagia) and is requesting an alternative method of drug delivery.
- Where the pain control might be improved by reliable administration. This might be useful in patients with cognitive impairment or those who for other reasons are not able to self-medicate with their analgesia.
- It can be used in combination with other enhancement strategies to produce synergistic effects.

Conditions in which transdermal patches are not to be used

- Cure for acute pain is required.
- Where rapid dose titration is required.
- Where requirement of dose is equal to or less than 30 mg /24 h.

Methods of preparation of transdermal patches[14-22]

Asymmetric TPX membrane method

A heat-sealable polyester film (type 1009, 3m) with a 1cm diameter concave can be utilized to manufacture a prototype patch. This film will serve as the backing membrane. The drug sample is injected into the concave membrane, sealed with an adhesive, and covered with an asymmetric TPX {poly (4-methyl-1-pentene)} membrane. [(Preparing an Asymmetric TPX membrane): The dry/wet inversion method is used to create them. To create a polymer solution, TPX is dissolved in a combination of nonsolvent additives and a solvent (cyclohexane) at 60°C. Using a Gardner knife, the polymer solution is cast to a predetermined thickness on a glass plate after being maintained at 40°C for 24 hours. After that the casting film is evaporated at 50°C for 30 sec, then the glass plate is to be immersed immediately in coagulation bath [maintained the temperature at 25°C]. After 10 minutes of immersion, the membrane can be removed, air dry in a circulation oven at 50°C for 12 hrs.

Circular Teflon mould method

Solutions containing polymers in various ratios are used in an organic solvent. Calculated amount of drug is dissolved in half the quantity of same organic solvent. Enhancers in different concentrations are dissolved in the other half of the organic solvent and then added. Di-N- butyl phthalate is adhesive material will be added to the drug solution and dissolved. A custom-made aluminium former is lined with aluminium foil and the ends blanked off with tightly fitting cork blocks.

Mercury substrate method

In this method drug is dissolved in polymer solution along with plasticizer. The above solution is to be stirred for 10- 15 minutes to produce a homogenous dispersion and poured in to a leveled mercury surface, covered with inverted funnel to control solvent evaporation.

By using "IPM membranes" method

In this method drug is dispersed in a mixture of water and propylene glycol containing carbomer 940 polymers and stirred for 12 hrs in magnetic stirrer. The dispersion is to be neutralized and made viscous by theaddition of triethanolamine. Buffer pH 7.4 can be used inorder to obtain solution gel, if the drug solubility inaqueous solution is very poor. The formed gel will beincorporated in the IPM membrane.

By using "EVAC membranes" method

Polyethylene (PE), ethylene vinyl acetate copolymer (EVAC) membranes, and 1% carbopol reservoir gel can all be utilized as rate control membranes to prepare the goal transdermal therapeutic system. Gel is made with propylene glycol if the medication is not soluble in water. Propylene glycol is used to dissolve the drug. Carbopol resin is then added to the mixture and neutralized using a 5% w/w sodium hydroxide solution. The medication (in gel form) is applied to a backing layer sheet that covers the designated area. To create a leak-proof device, a rate-regulating membrane will be placed over the gel and the edges will be heated to seal.

Aluminium backed adhesive film method

Transdermal drug delivery system may produce unstable matrices if the loading dose is greater than 10 mg. Aluminium backed adhesive film method is a suitable one. For preparation of same, chloroform is choice of solvent, because most of the drugs as well as adhesive are soluble in chloroform. The drug is dissolved in chloroform and and adhesive material will be added to the drug solution and dissolved. A custom made aluminum former is lined with aluminum foil and the ends blanked off with tightly fitting cork blocks.

Preparation of TDDS by using Proliposomes

The proliposomes are prepared by carrier method using film deposition technique. From the earlier reference drug and lecithin in the ratio of 0.1:2.0 can be used as an optimized one. The proliposomes are prepared by taking 5mg of mannitol powder in a 100 ml round bottom flask which is kept at 60-70°c temperature and the flask is rotated at 80-90 rpm and dried the mannitol at vacuum for 30 minutes. After drying, the temperature of the water bath is adjusted to 20-30℃. Drug and lecithin are dissolved in a suitable organic solvent mixture, a 0.5ml aliquot of the organic solution is introduced into the round bottomed flask at 37℃, after complete drying second aliquots (0.5ml) of the solution is to be added. After the last loading, the flask containing proliposomes are connected in a lyophilizer and subsequently drug loaded mannitol powders (proliposomes) are placed in a desiccator over night and then sieved through 100 mesh. The collected powder is transferred into a glass bottle and stored at the freeze temperature until characterization.

By using free film method

Casting on a mercury surface creates a free film of cellulose acetate. Chloroform is to be used to make a 2% w/w polymer solution. Plasticizers must be added at a 40% weight-to-weight ratio of the polymer. A glass ring that sits on the mercury surface in a glass Petridish was filled with five milliliters of the polymer solution. Over the Petridish, an inverted funnel is used to regulate the solvent's rate of evaporation. After the solvent has completely evaporated, the mercury surface is examined to detect the creation of a layer. Before being used, the dried film will be removed and kept in a desiccator between the wax paper sheets. It is possible to create free films with varying thicknesses by adjusting the volume of the polymer solution.

Recent advances in the field of transdermal patches[23,24]

1. Patch technology for protein delivery
2. Pain-free diabetic monitoring using transdermal patches
3. Testosterone transdermal patch system in young women with spontaneous premature ovarian failure
4. Transdermal Patch of Oxybutynin used in overactive bladder (OAB)
5. Pain relief
6. Molecular absorption enhancement technology.

Evaluation of transdermal patches

Drug Excipients Interaction Studies

The drug and excipients should be compatible to produce a stable product, and it is mandatory to detect any possible physical and chemical interaction. Interaction studies are
commonly carried out using thermal analysis, FT-IR studies, UV and chromatographic techniques by comparing their physiochemical characters such as assay, melting endotherms, characteristic wave numbers, and absorption maxima etc [25].

Flatness Test

Three longitudinal strips are to be cut from each film at different portion like one from the center, other one from the left side and another one from the right side. The length of each strip was measured and the variation in length because of non-uniformity in flatness was measured by determining percent constriction, with 0% constriction equivalent to 100% flatness [26].

Thickness

The thickness of transdermal film is determined by travelling microscope, dial gauge, screw gauge or micro meter at different points of the film.

Drug Content

A specified area of the patch is to be dissolved in a suitable solvent in specific volume. Then the solution is to be filtered through a filter medium and analyse the drug content with the suitable method (UV or HPLC technique). Each value represents average of three samples.[27-28].

Weight Uniformity

The prepared patches are to be dried at 60℃ for 4 hrs before testing. A specified area 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. [29].

Uniformity of weight

Weight variation is studied by individually weighing 10 randomly selected patches and calculating the average weight. The individual weight should not deviate significantly from the average weight.

Percentage Moisture Uptake

The weighed films are to be kept in desiccators at room temperature for 24 hrs containing saturated solution of potassium chloride inorder to maintain 84 % RH. After 24 hrs the films are to be reweighed and determine the percentage moisture uptake from the below mentioned formula [30,31].

Percentage moisture uptake = [Final weight-Initial weight/initial weight] × 100.

Moisture Loss

The prepared films are to be weighed individually and to be kept in a desiccator containing calcium chloride at 40°C. After 24 hrs the films are to be reweighed and determine the percentage of moisture loss from the below formula [32].

% Moisture Loss = [Initial wt – Final wt/ Final wt] × 100

Water Vapor Transmission Rate (WVTR) Studies

Glass vials of equal diameter were used as transmission cells. These transmission cells were washed thoroughly and dried in oven at 100 °C for some time. About 1g anhydrous calcium chloride was placed in the cells and respective polymer film was fixed over brim. The cell were accurately weighed and kept in a closed desiccator containing saturated solution of potassium chloride to maintain a relative humidity of 84%. The cells were taken out and weighed after storage. The amount of water vapor transmitted was found using following formula [32,33]

Water Vapor Transmission Rate = Final Weight –Initial Weight/ Time X Area

It is expressed as the number of grams of moisture gained/hr/cm.sq.

Swellability

The patches of 3.14 cm² was weighed and put in a petri dish containing 10 ml of double distilled water and were allowed to imbibe. Increase in weight of the patch was determined at preset time intervals, until a constant weight was observed [34].

Degree of swelling (S) was calculated using the formula,

S (%) = Wt – Wo/Wo × 100

Where S is percent swelling, Wt is the weight of patch at time t and Wo is the weight of patch at time zero.

Folding Endurance

A strip of specific area is to be cut evenly and repeatedly folded at the same place till it broke. The number of times the film could be fold at the same place without breaking gave the value of the folding endurance.[35]

Tack properties

It is the ability of the polymer to adhere to substrate with little contact pressure. Tack is dependent on molecular weight and composition of polymer as well as on the use of tackifying resins in polymer.

Thumb tack test

The force required to remove thumb from adhesive is a measure of tack.

Rolling ball test

This test involves measurement of the distance that stainless steel ball travels along an upward facing adhesive. The less tacky the adhesive, the further the ball will travel.

Quick stick (Peel tack) test

The peel force required breaking the bond between an adhesive and substrate is measured by pulling the tape away from the substrate at 90 at the speed of 12 inch/min.

Probe tack test

Force required to pull a probe away from an adhesive at a fixed rate is recorded as tack.

Polariscope Examination: Examine the drug crystals in the patch using a polariscope to determine if they are crystalline or amorphous.

Technique for the advancement of TDDS

Technique for the advancement of tdds are shown below in fig no.**9:**

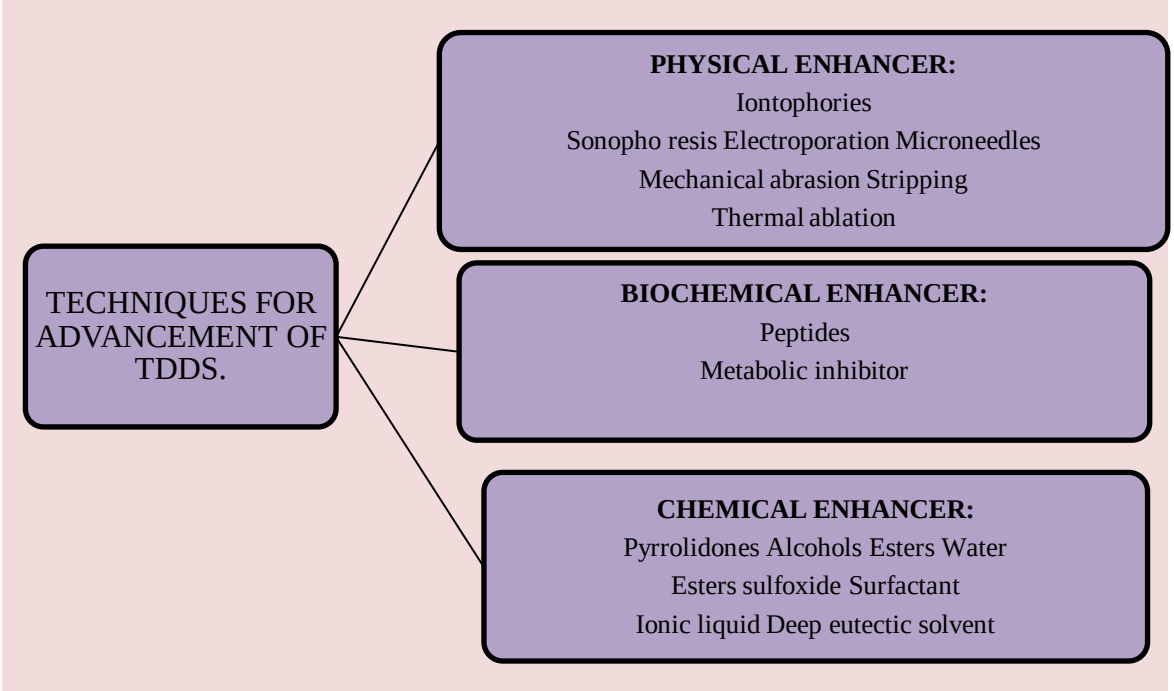

Fig.9: Techniques for the advancement of TDDS

Elaborating the methods to improve drug delivery through the skin:

Physical enhancer

Iontophoresis: Utilize selectrical current, typically around 500microamperescm².

- Enhances drug flow across the skin.
- Factors like current profile, valency, and polarity influence effectiveness.

Electroporation: Brief, high-voltage electric current creates small pores in the skin.

- Typically employs high voltage(e.g.,1000V)and short pulses (milliseconds).
- Suitable for lipophilic drugs with a molecular weight over7kgDalton.

Ultrasound: Utilizes high-frequency sound waves (20 kHz to 10 MHz) to disrupt the skinbarrier.

- Appliedat an intensity of up to 3Wcm³.
- Improves transdermal drug distribution by facilitating penetration through the skin.

Microscopic and Spectroscopic Examination: Microscopy is used to assess the drug's solubility and its possible interaction of the drug with the polymer and different spectra analysis software is used to determine the spectra of tested patches[36].

Invitro Drug Release Studies: Assess drug release from the patches using the paddle over disc method and analyze the samples by UV or HPLC.

In Vitro Skin Permeation Studies: Conduct permeation studies on rat skin to determine flux and permeability coefficients.

Skin Irritation Study: Assess skin irritation and sensitization on rabbits after applying the patch for 24hours.[37]

Stability Studies

Stability studies are to be conducted according to the ICH guidelines by storing the TDDS samples at 40±0.5℃ and 75±5% RH for 6 months. The samples were withdrawn at 0, 30, 60, 90 and 180 days and analyze suitably for the drug content[38,39].

Chemical enhancement: -Uses chemical compounds to modify the skin barrier function.

Allows drugs to penetrate the skin and enter the systemiccirculation.

Substances such as a mines, alcohol, fatty acids, esters, surfactants, and phospholipids can be employed.

1. Drug/Prodrug: Use of prodrugs to enhance transdermal drug distribution.
   - Prodrugs are chemical derivatives of the original drug designed to improve solubility and partition coefficient in the stratum corneum.
2. Eutectic System: Involves a chemical compound or element that

solidifies at a lower temperature compared to other compositions.
- Can be used to optimize drug formulations for transdermal delivery

These methods are employed to enhance the effectiveness of transdermal drug delivery, allowing for better drug absorption through the skin and into the blood stream[40].

Transdermal patches in present scinerio: marketed products

Transdermal product sales have been steadily increasing, and this trend is probably going to continue. Globally, patients are experiencing significant therapeutic benefits from a rising variety of TDD medicines. Currently, around 35. TDD products are authorized for sale in the United States, and roughly 16 active components are authorized for usage in TDD products worldwide. The table gives detail information of the different drugs which are administered by this route and the common names by which they are marketed, it also gives the conditions for which the individual system is used. [41,42]

TDDS marketed products

Product Name	Drug	Indication	Manufacturer
Astherol	Tolubuterol	Anti-asthematic	Bliss GVC Pharma Limited (www.blissgvs.com)
Alora	Estradiol	Postmenstrual syndrome	TheraTech/ProctolandGamble
Androderm	Testosterone	Hypogonadismin males	TheraTech/GlaxoSmithKline
Catapres-TTS	Clonidine	Hypertension	Boehringer Ingelheim(Ridgefield,CT)
Climaderm	Estradiol	Postmenstrual syndrome	EthicalHoldings/Wyeth-Ayerest
ClimaraPro	Estradiol/levonorgestrel	Menopausal symptoms	Bayer Healthcare Pharmaceuticals(Wayne, NJ)
CombiPatch	Estradiol/Nore thindrone	Hormone replacementtherapy	Noven,Inc./Aventis
Deponit	Nitroglycerin	Anginapectoris	Schwarz-Pharma
Duragesic	Fentanyl	Moderate/severepain	Alza/JanssenPharmaceutica
Daytrana	Methylphenidate	Attentiondeficithyperactivity disorder	Shire(Wayne,PA)
Estraderm	Estradiol	Postmenstrual syndrome	Alza/Norvatis
Exelon	Rivastigmine	Dementia	Novartis(EastHannover,NJ)(Hanumanaik,2012)
Emsam	Selegiline	Majordepressive disorder	Bristol-Myers Squibb (Princeton,NJ)
Fematrix	Estrogen	Postmenstrual syndrome	EthicalHoldings/SolvayHealthcareLtd
Gelnique	Oxybutynin	Overactive bladder	Anurol(www.mayoclinic.org)
Habitraol	Estradiol	Postmenstrualsyndrome	Parke-Davis
Ionsys	Fentanyl HCl(iontophoresis)	Acute postoperativepain	Alza,MountainView,CA
Iontocaine	Lidocaine/epinephrine (iontophoresis)	Localdermal Analgesia	Iomed(SaltLakeCity,UT)
Lidoderm	Lidocaine	Post-herpetic neuralgiapain	EndoPharmaceuticals(Chadds FordPA)
Nicoderm,Habitrol,Prostep	Nicotine	Smoking cessation	GlaxoSmithKline (Philadelphia,PA),NovartisConsumer Health (Parsippany,NJ) Elan (Gainesville,GA)
Nitrodisc	Nitroglycerin	Anginapectoris	Roberts Pharmaceuticals
Nicotrol	Nicotine	Smokingcessation	Cygnus Inc./McNeil Consumer Products, Ltd.
OrthoEvra	Ethinyl estradiol/norelgestromin	Contraception	Ortho-McNeil Pharmaceutical (Raritan,NJ)
Oxytrol	Oxybutynin	Overactive bladder	WatsonPharma(Corona,CA)
SonoPrep	Lidocaine(ultrasound)	Localdermal anesthesia	Echo Therapeutics (Franklin, MA)
Synera	Lidocaine/tetracaine	Localdermal analgesia	EndoPharmaceuticals(Chadds Ford,PA)
Testoderm	Testosterone	Testosterone Deficiency	Alza,MountainView,CA

Transderm-Scope	Scopolamine	Motionsickness	Novartis Consumer Health (Parsippany,NJ)
Transderm-Nitro	Nitroglycerine	Anginapectoris	Novartis(East Hannover,NJ)

Conclusion

In Conclusion, transdermal drug delivery systems (TDDS) are a promising approach to drug delivery, with features including consistent drug release, ease of use, and possible advantages for particular patient populations.A precise, preset medication is delivered using transdermal patches via transdermal drug delivery systems, which absorb the medication through the skin and into the bloodstream. As a result, transdermal patches provide a painless, non-invasive way to administer medication with the added advantage of offering a steady therapeutic dose over a set amount of time. The few other side effects are skin dermatitis, ineffectiveness for medications that need a high blood drug level, and occasionally an unintentional and excessive drug release.It is obvious that TDDS technology will play a bigger and bigger part in contemporary healthcare as research and development continue to improve it, offering safer and more effective ways to give patients their necessary pharmaceuticals.

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