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TRANSDERMAL DRUG DELIVERY PATCHES: AN OVERVIEW

¹Tushar C. Anare, ²Prof. Hemlata Nimje, ³Sauarbh N. Pawale

¹M. Pharmacy, ²M. Pharmacy (Pharmaceutical Chemistry)

^{1,3}Department of Pharmaceutical Quality Assurance

¹JSPM'S Charak College of Pharmacy and Research Wagholi, Pune, India

Abstract:

Transdermal drug delivery (TDD) could be a non-invasive route of drug administration, however its application is restricted by the low porosity of the skin. It's a gorgeous different technique to the traditional techniques for the administration of general approaches. The major site of application is skin for each native and general effects. The main barrier is that the stratum corneum to penetrate the drug through the skin membrane. As a result, fully different approaches to penetration improvement are wont to avoid stratum corneum and to expand the flow through the skin membrane. the new active rates of controlled transdermic drug delivery system (TDDS) technology are known, developed, and marketed for the TDD. This review presents, the structure of the skin, the pathways of penetration through the skin, fully different approaches to boost penetration, transdermic patches to optimize the transdermic delivery system into a decent drug delivery system.

Index Terms- Transdermal patches, Penetration enhancers, Transdermal Drug Delivery System (TDDS).

INTRODUCTION:

Currently, transdermic drug delivery is one of the foremost promising methods for drug application. Increasing the number of medications is being added to the list of therapeutic agents that will deliver to the circulation via the skin. The transdermal route offers significant benefits over conventional dosage forms such as tablets and injections, including preventing the first-pass metabolism by the liver. In transdermal drug delivery system contain drug at the defined surface area which delivers a specific amount of drug to the surface of skin at a predefined rate. This technique overcomes the disadvantages associated with oral products. Therefore, the aim of this article is to explain the structure, routes, criteria of selection, approaches, etc.

During the past two decades, monumental efforts have targeted on improving the penetration of medication through the intact skin by a large range of physical and chemical techniques like iontotherapy, sonophoresis, electroporation, microneedles, magnestophoresis, and electrom beam irradiation. However, the routine use of transdermic delivery systems only became a standard apply within the latter third of the twentieth century once delivery technology was developed to modify precise and consistent administration through the skin for general effects. Transdermal delivery is additionally accustomed manufacture clinical effects, like anaesthesia and anti-inflammatory activity, deep within or below the skin. In distinction, topical delivery seeks to treat superficial, although generally very serious, skin problems through a relatively native action.

HISTORY:

Topical remedies anointed, bandaged, rubbed or applied to the skin (Figure 1A) are probably to possess been used since the origin of man, with the practices changing into evident with the looks of written records, like on the clay tablets utilized by the Sumerians (Kramer, 1963). Indeed, it's been urged that a liquefied ochre-rich mixture, created some 100 000 years past and located at the Blombos drop South Africa, might are used for adornment and skin protection (Henshilwood et al., 2011). Ancient Egyptians used perfumes (e.g. Amygdalus communis amara, peppermint and rosemary) and alternative ingredients to create their cosmetic and dermatologic product (unguents, creams, pomades, rouges, powders, and eye and nail paints) (Forbes, 1955). The mineral ores of copper (malachite: green) and lead (galena: dark grey) were wont to prepare kohl, a paste accustomed paint the eyes. Red ochre was used as a lip or face paint, and a combination of powdery lime and oil was used as a cleansing cream (Lucas and Harris, 1962).

The traditional lead-based product were applied for each look and, primarily based upon non secular beliefs, for cover against eye diseases (Tapsoba et al., 2010). However, these effects may have been real as recent studies involving incubation of low lead ion concentrations with skin cells produced NO (Tapsoba et al., 2010), which is known to provide defence against infection (Coleman, 2001).

ADVANTAGES OF PATCHES OVER THE DOSAGE FORMS^[2-4]:

- Reduce systemic drug interaction
- Increase compliance/ convenience
- Give steady delivery/ blood vessels
- Eliminate the first-pass metabolism
- Will minimize abuse/ diversion
- Allow dose discontinuance via removal
- Provides product life cycle extension opportunities at a lower cost with lower risks
- Improved bioavailability
- Longer period of action
- More uniform plasma levels

LIMITATIONS OF TDDS^[5]:

1. Chances of local irritation at the site of application
2. Erythema, itching, and native swelling is caused by the drug, the adhesive, or other additives inside the patch formulation.

STRUCTURE OF SKIN BARRIER^[6-8]:

Skin is largest human organ of our body composed of the many layers: the corneum (uppermost layer), the viable cuticle, the dermis, and additionally the lower layers of fatty tissue (fig.1). The corneum consists of flat, roughly hexagonally formed, part overlapping cells, with a thickness of zero.3 μm and a diameter of three0 μm . Slightly below the corneum is that the viable cuticle, that made from 3 layers: the stratum, spinosum, and basal. it's a cell thickness of between 50-100 μm . below the viable cuticle stratum is present. stratum thickness is regarding 2000-3000 μm and consists of a matrix of loose animal tissue composed of fibrous supermolecule closed in associate amorphous ground substance. For the past few years, the transcutaneous route has been hand-picked for the delivery of bound medicine. However, its use is proscribed thanks to the low permeableness of the skin to several medicine.

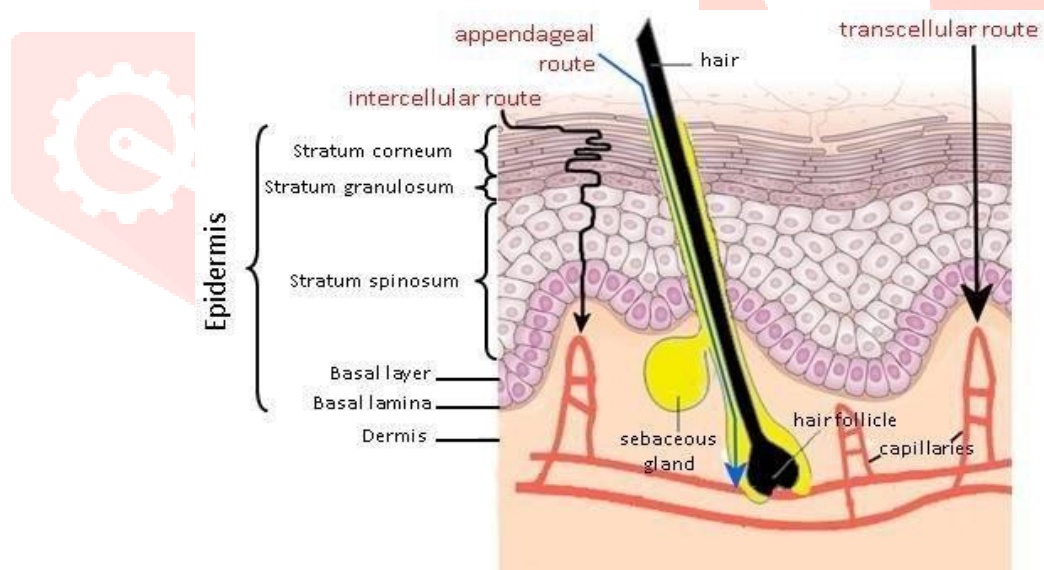


Fig.1 Anatomical and physiological structure of the skin.

ROUTES OF PENETRATION^[9-11]:

A transdermic drug delivery system can be the foremost appropriate system for long treatment or for a multi-dose treatment as a result of completely different transdermic patches area unit ready for associate degree extended amount throughout an acceptable dose proving treatment from daily to even up for seven days. To permeate a molecule within the traditional human intact skin there area unit 2 diffusion pathways: the appendageal and also the transepidermal pathway. A molecule have to be compelled to have adequate lipophilicity and optimum relative molecular mass to penetrate the intact skin. hydrophilic medication divided via living thing domains, whereas oleophilic permeants (octanol/water log $K > 2$) divided the hypodermic (SC) through the article route. Most of the molecules travel to the stratum corneum by both routes. The transport of various drug molecules through the skin, directly restricted by the barrier properties of the epidermis. To avert these difficulties in permeation through SC, carrier vesicles will be used as penetration enhancers for avoiding the SC barrier. All strategies square measure stratum with four elements that square measure necessary, a scheme that transmits system energy to those positions wherever it's required for overall performance, a sway system that regulates and controls system performance, elements that truly perform the most perform of the system, associated additionally an energy supply. These four crucial elements square measure terribly essential to finish a TDDS system

to perform at a rate that's high. several vital factors related to the event this is often definitely a lot of of drug delivery systems can probably to be advancements in precisely however effectively energy is transmitted throughout the systems. the connection between stratum drug delivery systems at the side of alternative gift and new systems square measure outlined by numerous laws. The Next-generation stratum drug delivery systems can show associate improved degree of coordination among many elements of the system, and intentional dis-coordination among alternative elements of the system. the aim of this dis-coordination or coordination bydesign is often to realize important breakthroughs in system overall performance.

TRANSDERMAL PATCHES^[13-18] :

A pad is additionally known by the name of transdermal patch that's wont to deliver the precise quantity of dose through skin and it directly goes into the blood (Fig. 2). The transdermic drug delivery route a bonus on differing types like oral, endovenous, topical, etc provides a controlled unleash of the drug into the patient. a large kind of medicaments ar delivered by transdermic patches. a replacement crystal reservoir technology has commence successfully with the advancement in TDDS that manufacture comparable smaller patches with a additional controlled and sustained unleash. The success of a pad depends on a range of biological physiological, organic chemistry, and biophysical factors likewise because the because the Direct application on the body

- Drug metabolism/first-pass metabolism
- State of skin association pH and totally different physiochemical drug properties
- Porosity of the membrane at intervals the stratum drug delivery system
- lipid solubility/lipophilicity
- Degree of the partitioning of drug and associated elements
- Structure & size of the molecule that's associate degree indicator of diffusivity
- Depot of the drug in skin
- Composition, integrity & thickness of the stratum
- Alteration of drug flow within the skin by additives and body temperature
- Interactions between molecules and molecules

COMPONENTS OF A TRANSDERMAL PATCH^[19-20] :

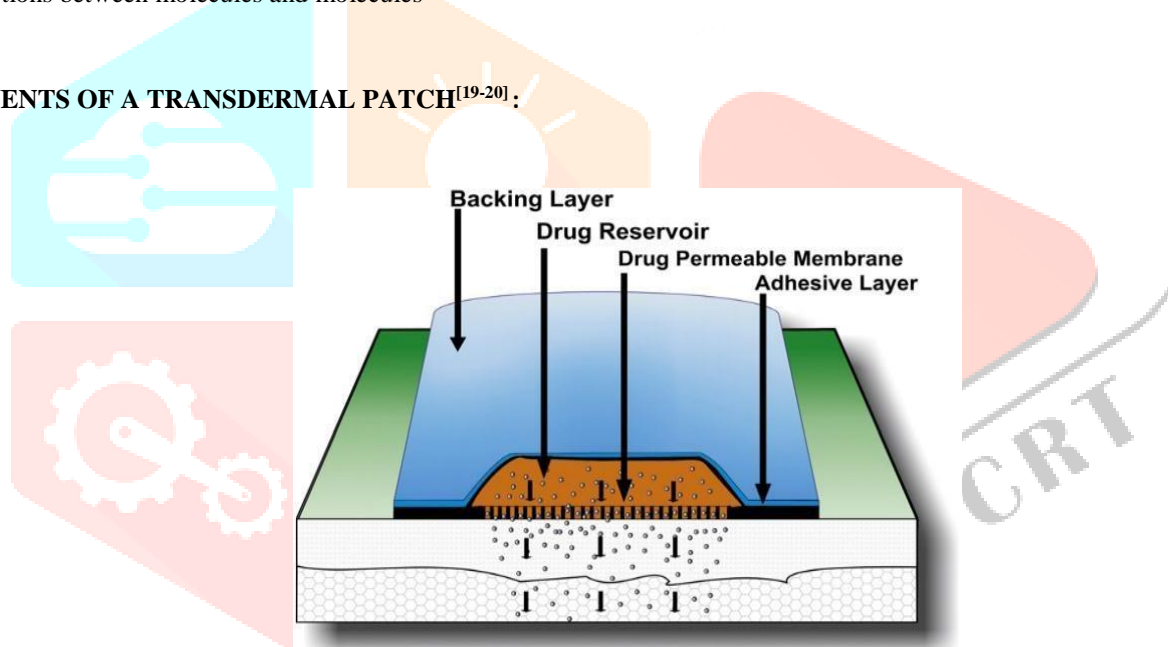


Fig.2: Transdermal patch

The transdermal patch consists of the following components:

- Liner - It defend the patch once we hold on it for a protracted amount of your time. Before use the pad liner is removed Ex: Polyester film.
- Drug-Drug resolution is in direct contact with the discharge liner Ex: alkaloid and oestrogen.
- Adhesive – it's a cloth that helps adhere to the parts of the patch and conjointly the patch to the skin Ex: Acrylates, polyisobutylene, silicones.
- Membrane - management the discharge of medication from the reservoir and multilayer patches.
- Backing -It could be a method by that we are going to save the patch from the outer atmosphere. Ex: polysaccharide derivatives, polyvinyl alcohol, polypropene chemical element rubber.
- Permeation enhancers - The controlled quantity of drug is discharged by the employment of permeation enhancers Ex: alcohol, ethanol, terpenes, pyrrolidone, surfactants like metallic element lauryl salt, Pluronic f127 etc.

TYPES OF TRANSDERMAL PATCHES^[21-29] :

Single-layer Drug-in-adhesive:

The adhesive layer consists of the drug and it not only serves to adhere the various layers collectively however with the whole system to the skin but is additionally responsible for the releasing of the drug. On the outer side of the adhesive layer, there is a lining of the temporary liner and a backing layer (Fig.3d).

Multi-layer Drug-in-Adhesive:

It is comparable to the single layer system in respect that each adhesive layer also responsible for the release of the drug. The multilayer system is different it provides another layer of drug-in-adhesive, normally separated through a membrane (but not in all cases). This patch also surrounded via a temporary liner-layer and a permanent backing (Fig. 3c).

Reservoir System:

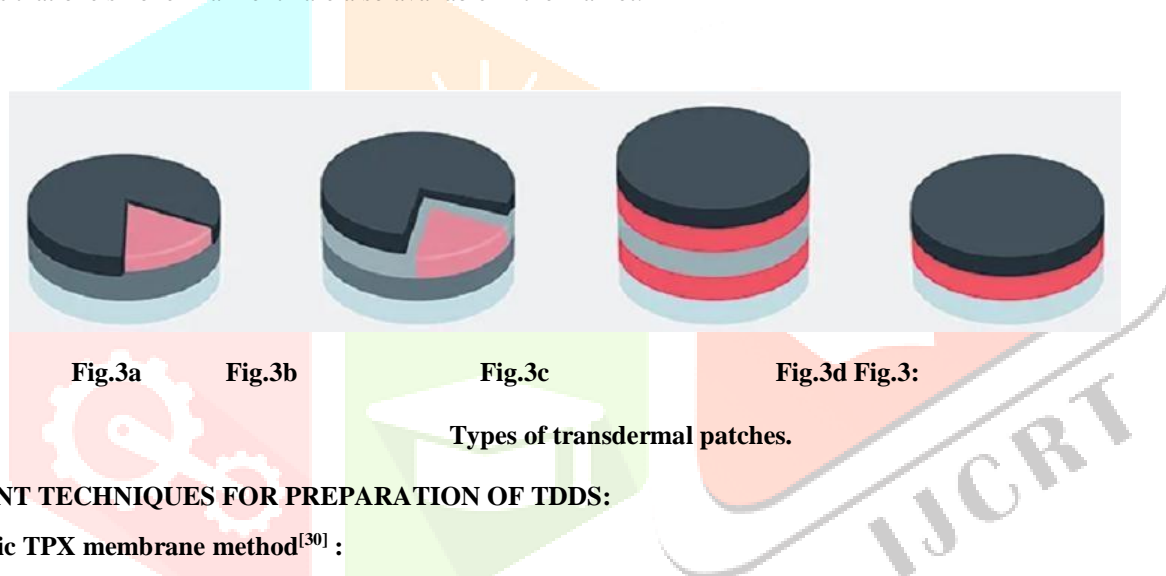
In a reservoir system, the drug reservoir is enclosed between an impenetrable backing layer and a rate-controlling membrane. The rate-controlling membrane is microporous or nonporous which can release the drug. Within the drug reservoir compartment, the drug can be in the form of a solution, suspension, gel. The hypoallergenic adhesive polymer can be utilized as an outer surface polymeric membrane that is compatible with the drug. This patch is backed via the backing layer (fig. 3b). Zero-order kinetics is followed through this system.

Micro reservoir system:

The drug delivery system is a combination of a reservoir and a matrix system in this type. The drug reservoir is produced by the drug is suspending in an aqueous solution of watersoluble polymer and at that point dispersing the solution homogeneously in a lipophilic polymer to produce lots of unreachable, microscopic spheres of drug reservoirs. This thermodynamically unstable dispersion is stabilized rapidly by promptly cross-linking the polymer situated by utilizing cross-linking agents.

Vapour Patch:

The adhesive layer serves to follow the different layers together yet in addition to discharge vapour. The vapour patches are new for the market and release essentials oils for up to 6 h. Essential oils are discharged from this patch and they are used only in cases of decongestion mainly. Controller vapour patches are available within the market that improves the quality of sleep. Vapour patches that diminish the number of cigarettes that one smoke in a month are also available in the market.

**DIFFERENT TECHNIQUES FOR PREPARATION OF TDDS:****Asymmetric TPX membrane method^[30] :**

The prototype patch is made with a polyester film (type 1009, 3m) that is heat-sealable using a concave 1cm diameter used as a back membrane. Sample of the drug is administered to the concave membrane sheet, which is covered by the TPX {poly(4-methyl-1-pentene)} membrane layer and sealed by the adhesive layer.

Asymmetric TPX membrane layer preparation^[30]:

They are fictitious through the utilization of the inversion method that's dry/wet. TPX is dissolved during a mixture of solvent (cyclohexane) and ingredients that are non-solvent additives at sixty °C to form a compound resolution. the answer of compound could be a store at 40 °C for twenty-four h and stitch a glass plate to a thickness that's pre-determine with a gardener knife. After that, the casting film is gaseous at fifty °C for 30 sec, and later, the glass plate is quickly be immersed during a clotting tub at a temperature of 25 °C. The membrane layer is removed, dry in a very circulation oven at 50 °C for 12 h when 10 minutes of immersion.

Circular teflon mould method^[31] :

The solution containing polymers in various proportions can be used within an organic solvent. The calculated quantity of drug is dissolved in half the amount of the same organic solvent. Enhancers in different concentrations are to be dissolved into the other half of the organic solvent afterward added. Di-N-butyl-phthalate is added as being a plasticizer into drug-polymer solution. the whole material can be stirred for 12 h and after poured into a circular teflon mould. The moulds is placed on a surface that is levelled covered with an inverted funnel to control solvent vaporization in a laminar flow, hood model with the speed of air 1/2 m/sec. The solvent is kept to evaporate for 24 h. Before evaluation, the dried films should be kept for the next 24 h at 25±0.5 °C in a desiccator's silica gel is containing before to eliminate aging effects. These types of films can be evaluated within certainly one week of their preparation.

Mercury substrate method^[32] :

In this technique, drug is dissolved up throughout a compound resolution at the aspect of plasticizer. Then the on high of resolution is to be mixed for 10-15 min to make a consistent dispersion and poured into a levelled mercury surface. At that point, associateswer} is roofed with associate inverted funnel to control solvent evaporation.

By using IPM membrane^[33] :

In this technique, the drug is spread during a mixture of water and propanediol, carbomer940 compound, and stirring during a magnetic stirrer for 12 h. The dispersion are neutralised, creating it viscous by the addition of tri-ethanolamine. Buffer pH seven are often used to induce resolution gel, within the technique that drug solubility in solution is poor. The shaped gel are often incorporated into the IPM membrane.

EVAC membranes method^[34] :

In this procedure to arrange the target therapeutic transdermic system, it's definitely I Chronicles saccharide reservoir gel, polythene (PE), ethene vinyl acetate polymer (EVAC) membranes is used as rate management membranes. If the drug isn't water soluble, propanediol is used for the preparation of the gel. The drug is dissolved in gas glycol; the on top of resolution is additional to carbopol organic compound and neutralised exploitation 5-hitter w/w hydrated oxide resolution. The drug (in the shape of a gel) is mounted on a backing layer sheet covering the required space. the speed management Membrane ought to be positioned over the gel and therefore the edges are sealed by heat to realize a leak-proof device.

Aluminium backed adhesive film method^[35] :

Transdermal drug delivery system can produce unstable matrices with a loading dose greater than 10 mg. Chloroform can be the preference of solvent for the preparation of aluminium backed film, because most drugs, as well as adhesives, are soluble in chloroform. The drug is dissolved in chloroform and the drug solution can be added to the adhesive material and dissolved. Former is lined with aluminium foil and the ends off with tightly cork block fitting.

Preparation of TDDS by using proliposomes^[36] :

The proliposomes area unit ready by a carrier technique film employing a deposition technique. Through the previous reference drug AND phospholipid among the quantitative relation of 1:2 will be used being an optimized quantitative relation. Proliposomes square measure ready by taking five mg of water pill powder in a very one hundred mil spherical bottom flask, which may be command at a 60-70°C temperature addition to the flask, turned at 80-90 revolutions per minute and vacuum-dried water pill for half-hour. once drying, the temperature of this water-bath is adjusted to 20-30 °C. Drug and phospholipid area unit dissolved within an appropriate organic solvent mixture. Aliquot of zero.5 mil of organic resolution is transferred to the spherical round-bottomed flask at 37°C containing water pill once complete drying of aliquots second (0.5 ml) of the answer is additional. once the ultimate loading, the flask proliposomes that square measure containing connected in a very lyophilizer and afterwards drug loaded water pill powders (proliposomes) area unit place in desiccators long then sieved through one hundred mesh. The collected powder is transferred directly into a glass instrumentality and hold on within the freeze temperature till characterization.

By using free film method^[37] :

Free film of cellulose ester is created by casting on a mercury surface. A book w/w chemical compound resolution is ready mistreatment chloroform. Plasticizers area unit supplemental at a amount of four-hundredth w/w of the chemical compound weight. five cubic centimeter of chemical compound resolution poured within a glass ring which might be placed over the mercury surface in a very glass dish. The evaporation rate of the solvent is regulated by putting the inverted funnel over the dish. The film formation is mentioned by perceptive the mercury surface when the whole evaporation of the solvent. The film, that is dry, is removed and deposited in desiccators between sheets of paper before it's used. Free films of various thickness may well be ready by ever-changing the amount of the chemical compound resolution.

FACTORS INFLUENCING TRANSDERMAL DRUG DELIVERY^[13]:

An effective drug that is transdermal could be formulated by considering three factors as Drug, Skin, and also vehicles. So factors affecting may be divided into classes as biological factors and physicochemical factors.

A. Biological factors:

1.Skin condition: Acids and alkalis, many solvents like chloroform, methanol damage the epidermis cells and penetration that is improved. The diseased state of the patient alters skin conditions. The intact skin is a better barrier but the above mentioned problems influence penetration.

2.Skin age: The skin that's young additional semipermeable than older. children area unit a lot of sensitive to skin absorption of poisons. Hence, skin age is simply one in all the issue penetration that's moving.

3.Blood supply: alterations in peripheral circulation can affect transdermal absorption.

4.Regional skin site: The thickness of the skin, the nature of the stratum corneum, and the density of the appendages differ from site to site. These components have a particular effect on penetration.

5.Skin metabolism: Skin metabolizes steroids, bodily hormones, chemical carcinogens, and some medications. So skin metabolism determines the effectiveness of drugs permeated through the skin.

6.Species differences: The thickness of skin and density of appendages, keratinization of skin differs from species to species, so affects the penetration.

B. Physicochemical factors:

1.Skin hydration: in-tuned with water the porosity of skin will increase considerably. association is that the most issue that's vital within the permeation of skin. that the use of humectants is performed in stratum delivery.

2.Temperature and pH: The permeation of the drug will increase multiple with temperature distinction. The diffusion constant reduces because the temperature falls. Weak bases and weak acids dissociate looking on the pH scale and pKa or pKb values. The proportion of unionized medication determines the drug concentration within the skin. Therefore, temperature and pH ar vital aspects of drug penetration that's moving.

3.Diffusion coefficient: Penetration of drugs depends on the diffusion coefficient of drug. The diffusion coefficient of a drug relies on properties of drug, diffusion medium, and interaction among them in a constant temperature.

4.Drug concentration: The flux is proportional to your concentration gradient across the concentration gradient and barriers are greater in the concentration of the drug will likely be more across the barrier.

5.Partition coefficient: The K that is optimal coefficient is needed for good action. Drugs with high K are not prepared to leave the lipid portion. Also, drugs with low K will not permeate.

6.Molecular size and form: Drug absorption is inversely associated with molecular weight small molecules penetrate quicker than large ones. The effect of molecular size is not known because of partition coefficient domination.

EVALUATION PARAMETERS:**Interaction studies^[5-43] :**

The integral a part of much all pharmaceutical indefinite quantity forms is that the excipients. the steadiness of the formulation between numerous factors depends on the compatibility of the drug with the excipients. The drug and excipients ought to be compatible to provide a stable product, and therefore it's needed to spot any doable physical and chemical interaction because it will influence the bioavailability and stability of the drug. Interaction studies ar sometimes administered in thermal analysis, FT-IR, UV, and activity techniques by scrutiny their physiochemical characters, as an example, assay, melting points, characteristic wave numbers, and absorption maxima, and so on.

Thickness of the patch^[44]:

The thickness of the drug-loaded patch is measured at numerous points by utilizing a digital micrometre and decides the common thickness and variance for the corresponding to make sure the thickness of the ready patch.

Weight uniformity^[44] :

The ready patches ar dried at 60 °C for 4h before testing. a selected region of the patch is remove numerous components and weigh within the digital balance. the common weight and variance values are to be calculated by the individual weights.

Folding endurance^[44] :

A strip of specific dimensions is cut equally and over once rolled-up at the same spot until it bust. while not breaking, the quantity of times the film can be rolled-up at the same spot and gave the worth of the folding endurance.

Percentage wet content^[44] :

The films being ready are severally weighted and placed in desiccators containing consolidated CaCl₂ at temperature for 24 hours. Then once 24h the films ar reweighed and confirm the proportion wet content from the below formula is mentioned.

Percentage wet Content = $[\text{Initial Weight} - \text{Final Weight}/\text{Final Weight}] \times 100$

Drug content^[45] :

A nominal space of patch is sometimes to be mixed in an exceedingly appropriate solvent during a specific volume. Then the answer would be filtered through a filter medium and also the medication content is analysed exploitation the appropriate technique (UV or HPLC technique). every price ought to represent the common of 3 totally different samples.

Uniformity of dosage unit test^[46] :

In this test, an accurately weighed portion of the patch will be cut into small pieces and transferred to a volumetric flask dissolve within a suitable solvent and sonicate for total extraction of the drug through the patch and made up to the mark with same. The resulting solution was allowed to settle for about an hour, and the supernatant was then diluted to provide the desired concentration with the required solvent. The solution was filtered using a membrane filter this is certainly 0.2µm and examined by suitable analytical technique (UV or HPLC) plus the drug content per piece should be calculated.

Polariscope examination^[47] :

This take a look at are performed to look at the drug crystals from the patch by polarimeter. a definite expanse of the film should be unbroken on the slide of the item, and also the drug crystals should be ascertained to differentiate whether or not the drug seems as a crystalline or amorphous kind within the patch.

Shear adhesion test^[46]:

This take a look at is distributed to measuring of the cohesive strength of Associate in Nursing adhesive compound. It might be influenced by the mass, the number of crosslinking, and also the composition of compound, type, and also the level of tackifier else. The adhesive-coated tape is applied on a stainless-steel plate than specified weight is hanging from the tape, to have an effect on it actuation during a direction parallel to the plate. Shear adhesion strength is decided by activity the time to tug the tape off from the plate. The longer the time needed for removal, the bigger the shear strength.

Thumb tack test^[46]:

The thumb is just ironed onto adhesive and also the connected tack property is detected that may be a qualitative take a look at.

Flatness test^[47]:

Three longitudinal strips area unit cut from every film at completely different areas like one through the centre, alternative one through the left facet, and one from the proper facet. The length of every strip was measured and also the distinction long as a results of the non-uniformity in flatness was calculated by the determination of % constriction, with zero constriction similar to 100% flatness.

Rolling ball tack test^[48]:

The softness is calculated by this check of a compound that relates to talk. throughout this check, a stainlesssteel ball of 7/16 inches in diameter is introduced on a track this could be undoubtedly inclined that it rolls down and comes into contact with horizontal, upward facing adhesive. the house the ball travels on the glue provides the measurement of the track, which may be expressed in inches.

Quick stick test^[49]:

The tape is force from the substrate at 90 °C at a speed of 12inches/min. to interrupt the bond between substrate and adhesive. The peel force needed is assessed and recorded as tack price, and expresses in ounces or grams per in. breadth.

Probe tack test^[48]:

The tip of the clean probe with definite surface roughness is brought into contact with adhesive, so once a bond is formed between adhesive and probe. it's mechanically broken by consecutive removal of the probe. The force required to tug the probe away through the adhesive at a collection rate is recorded as a tack and represented in grams.

In vitro drug release studies^[46]:

The paddle over disc technique (USP equipment V) is employed to see the discharge of the drug through the patch that's ready. Dry films of illustrious thickness are remove an exact form and weighed, then mounted over a glass plate with associate adhesive. Then glass plate was placed in 500 milliliter of the dissolution medium or buffer phosphate pH 7.4), and also the equipment was equilibrated to 37±0.5 °C. The paddle was then set a distance of two.5 cm through the glass plate and operated at a speed of {50|of fifty} rpm. samples may be withdrawn at correct time intervals up to 24 h and reviewed by Ultraviolet photometer or HPLC technique. The experiment is to be performed in triplicate also because the price that's mean be calculated.

In vitro skin permeation studies^[42]

Diffusion cell is used to carry out the permeation study on complete thickness abdominal skin of male Wistar rats evaluating 200-250g. Hair through the abdominal region becoming removed carefully by using a clipper this is certainly electric, the dermal side of the skin was completely cleaned with distilled water to remove any adhering cells or arteries, equilibrated for an hour in dissolution medium or phosphate buffer pH 7.4 before beginning the test and had been put on a magnetic stirrer through a tiny needle that is a magnetic uniform distribution of the diffusant. The temperature of this cell had been maintained at 32±0.5 °C using a thermostatically controlled heater. The rat-skin that is isolated piece is to be attached between the compartments of the diffusion cell, with the epidermis facing up into the donor compartment. Sample value of definite volume is to be taken off the receptor compartment at regular intervals and a volume this is certainly equal to fresh medium will be replaced. Samples are to be filtered through a filtering medium and certainly will be analyzed spectrophotometrically or HPLC. Flux could be determined directly as the slope for the curve between the steady state values for the quantity of drug permeated (mg cm⁻²) vs. time in hours and permeability coefficients had been deduced by dividing the flux by the initial drug load (mg cm⁻²).

Skin irritation study^[42]:

Healthy rabbits are widely used to perform skin sensitization and irritation testing. The dorsal surface (50 cm²) of the rabbit is usually to be clean and the hair removed by shaving and the surface cleaned by the application of rectified spirit and the representative formulations should be applied to the epidermis. The patch will be removed after 24 h and the skin is observed and classified into five grades on the basis of the extent of skin injury.

Stability studies^[38]:

Stability studies are performed based on the ICH guidelines by storing the TDDS samples at 40±0.5 °C and 75±5% RH for 6 months. The samples became withdrawn at 0, 30th, 60th, 90th, and 120th day and analyzed suitably for the drug content.

List of marketed transdermal products:**Table 1: Some marketed transdermal products.^[8] :**

| S.N. | Name of Product | Manufacturer | Drug | Uses |
|------|-----------------|--|--------------|------------------------------|
| 1 | Nicoderm | Alza/glaxo smithkline | Nicotin | Smoking cessation |
| 2 | Nicotrol | Cygnus inc./Mc Neil Consumer products Ltd. | | |
| 3 | Habitraol | Novartis | | |
| 4 | Prostep | Elan Corp./Lederle Labs | | |
| 5 | Androderm | Theratech/GalxosmithKline | Testosterone | Hypogonadism In males |
| 6 | Testoderm TTS | Alza | | |
| 7 | Lidoderm | Endo Pharmaceuticals | Lidocaine | Post-herpetic neuralgia pain |
| 8 | Fematrix | Ethical holdings/solvay healthcare LTD | Estrogen | Post menstrual syndrome |
| 9 | Oxytrol | Watson Pharma | Oxybutynin | Overactive bladder |
| 10 | Transderm Scop | Alza/Novartis | Scopolamine | Motion sickness |

CONCLUSION:

Transdermal drug delivery is one of the fastest-moving areas for novel drug delivery. Because of recent technological advances and the ability to deliver the drug systemically without rupturing the skin membrane, the transdermal route is now a commonly accepted route of drug administration. The transdermal drug delivery system (TDDS) is designed to control the release of drugs through the skin into the systemic circulation, maintaining efficacy. It provides the delivery of drugs at a reduced dosage that will protect the patient from harm caused by high doses with increased bioavailability. This can be accomplished by bypassing the hepatic metabolism. Almost all large and smaller pharmaceutical companies are developing TDDS. Potential developments in drug delivery systems include using advanced adhesive and/or enhancer technologies; and systems that exploit thermal, electrical, ultrasonic, or other sources of energy.

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