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An Overview on Transdermal Patches Along With Its Availability in Market

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ABSTRACT:
It was determined that the most common method of pharmaceutical administration is via the mouth, and a transdermal drug delivery system was offered as a potential alternative. A transdermal patch is a small adhesive patch that contains a measured dose of medication that is intended to be put to the skin and absorbed into the bloodstream over a certain period of time. It aids in the healing process once an injury has occurred. The controlled release of the medication into the patient is one advantage of transdermal drug delivery over other methods such as oral, topical, intravenous, intramuscular, etc. This can be achieved by a porous membrane covering a reservoir of medication or by the patient's body heat melting thin layers of medication embedded in the adhesive. Skin is a very effective barrier, hence transdermal administration techniques can only be used to deliver very small-molecule medicines. This overview page provides a general introduction to transdermal patches, including topics like patch types, patch preparation methods, patch factors, and so on.

Keywords:: TDDS, Transdermal patch, Matrix system, Reservoirsystem, Polyvinylchloride

INTRODUCTION:

The oral route of medication administration is often utilised, although it has substantial limitations, such as first pass metabolism, drug degradation, etc. in the gastrointestinal system as a consequence of enzymes, pH, etc. To address these issues, Chien (1992), Banker (1990), and Guy (1996, in that order) developed a novel medicine delivery system. This new method of administration used transdermal patches. In this approach medicated adhesive patches are developed which transfer therapeutically effective quantity of medicine across the skin when it put on skin. They come in a range of sizes and often have many active ingredients. Active compounds applied to intact skin are able to enter the bloodstream. A transdermal patch delivers a concentrated dosage of medication directly to the bloodstream via percutaneous absorption and subsequent diffusion[1].

There are three routes the drug might take to enter the body via the skin.

- By using hair follicles.
- Your oil glands (sebaceous).
- Via the sweat glands

In addition to its application in treating skin conditions, transdermal medication delivery systems have shown effective in the treatment of cardiovascular illness, chronic pain, nicotine withdrawal, and neurological diseases including Parkinson's[2].

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TYPES OF TRANSDERMAL DRUG DELIVERY SYSTEM

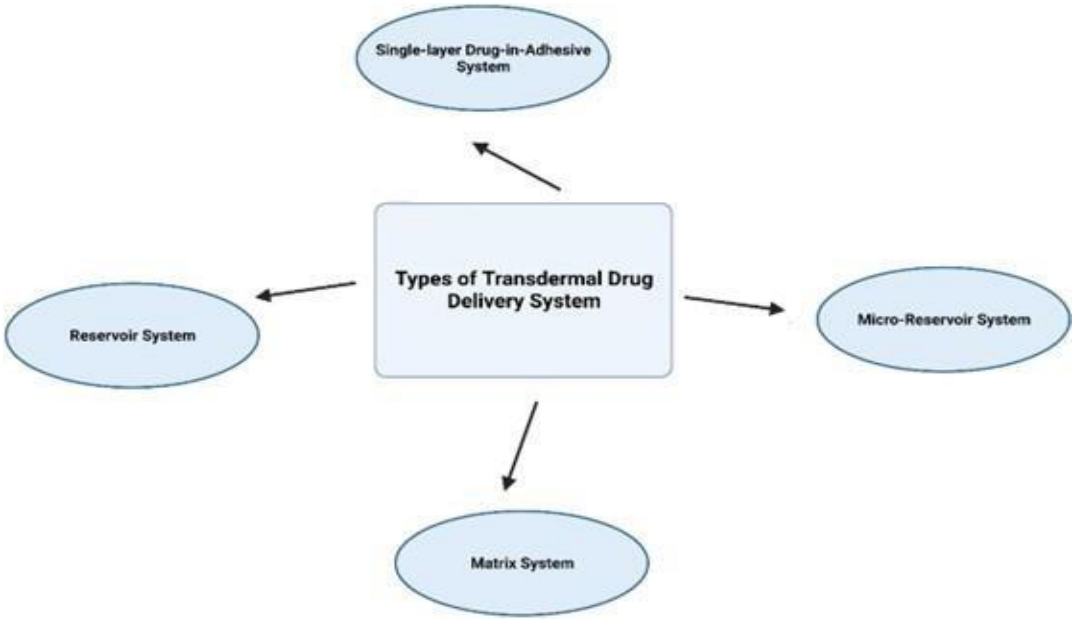

Fig. 1: Types of Transdermal Drug Delivery System

Drug Delivery System Single-layer Drug-in-Adhesive System:

The medication is embedded into the adhesive layer of this system in the form of a patch. The adhesive coating not only keeps everything in place but also administers the medicine as it bonds to the skin and the rest of the system. You'll find a backing and a short-term liner protecting the adhesive layer[3].

Reservoir System:

The drug reservoir in this system is sandwiched between the support layer and the rate-regulating membrane. Microporous rate- controlled membrane for medication release. The reservoir space is used to store the drug in a liquid form (such as a solution, suspension, or gel) or a solid polymer matrix[4].

Matrix System:

This system is of Two type

a) Drug-in-Adhesive System: For example, a drug reservoir might be made by first dispersing the drug in an adhesive polymer, and then either solvent casting or melting the adhesive (in the case of hot-melt adhesives) to spread the medicated polymer adhesive onto an impermeable backing layer [5].

b) Matrix-Dispersion System: Here, the medication is evenly distributed across a polymer matrix that may be either hydrophilic or lipophilic. This polymer, together with the medication, is then adhered to an occlusive base plate in a compartment made from a drug-impermeable backing layer. As opposed to putting the adhesive to the front of the drug reservoir, it is instead dispersed around the outside to produce a continuous sticky ring[6].

Micro-Reservoir System:

Reservoir and matrix-distribution systems work together to form this setup. The medicine is first dissolved in a water-soluble polymer solution, and then the solution is uniformly dispersed in a lipophilic polymer to create tiny, impermeable reservoirs[7].

COMPONENTS OF TRANSDERMAL DRUG DELIVERY SYSTEM

Polymer Matrix/ Drug Reservoir:

The medication is dissolved or suspended in a synthetic polymer basis. It has to be chemically and biologically compatible with the medicine and the rest of the system, including things like penetration enhancers. In addition, they need to be safe and capable of delivering a medicine as promised throughout the duration of the product's shelf life[8, 9].

Permeation Enhancers: Compounds used to increase drug candidate penetration through the

stratum corneum to achieve therapeutic concentrations. By interacting with the Stratum corneum, they make it more permeable[10].

a) Ideal Properties of Permeation Enhancers
i. They need to be safe for those with sensitive skin, no matter what kind of allergies they have.
ii. They shouldn't have any pharmacological action, meaning they shouldn't bind to the receptor site.
iii. It's important that they look well and feel good on the skin aesthetically[11].

Pressure Sensitive Adhesive (PSA): Aids in enhancing the transdermal patch's ability to stay in place on the skin. On a glossy surface, it peels off cleanly and leaves no residue[12].

Backing Laminate: It's a helping substance that doesn't let drugs or permeation boosters in. They have to get along with the drug's active component, booster, adhesive, and other excipients chemically. Films made of polyvinyl chloride, polyethylene, and polyester are examples [13].

Release Liner: When properly packaged, this is the only thing that can keep the patch safe while it's being applied. It consists of a base layer that might be[14]

a) Non-occlusive (e.g. paper fabric)
b) Occlusive (e.g. polyethylene, polyvinylchloride)

This material is either silicon or Teflon. The release liner must be impermeable to drug, penetration enhancers, and water while remaining chemically inert[15].

Other Excipients Like Plasticizers and Solvents

a) Chloroform, methanol, acetone, isopropanol, and dichloromethane are all examples of solvents that may be used.
b) Fillers: polyethylene glycol, propylene glycol, polybutyl phthalate, and triethyl citrate[16].

METHODS OF PREPARATION OF TDDS[17]

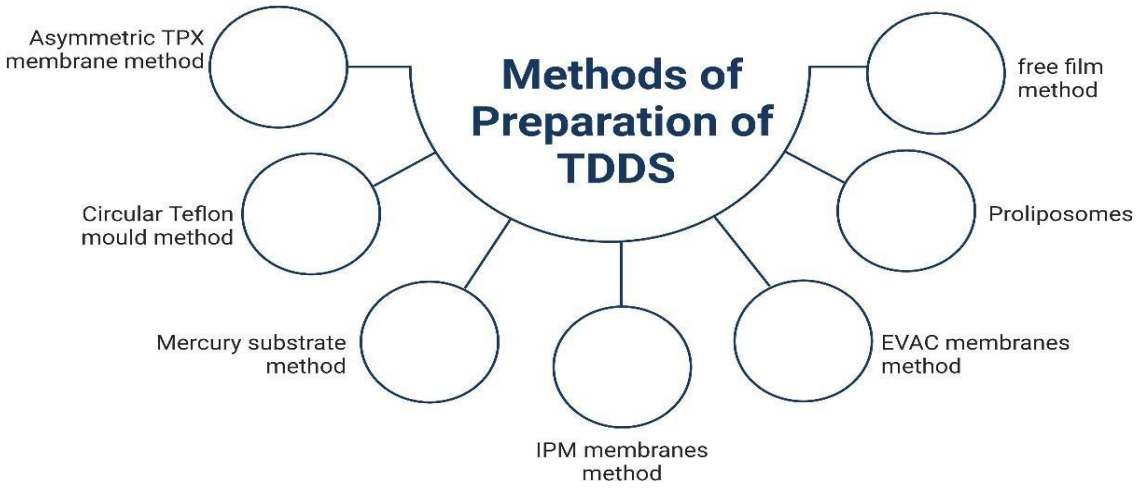

Fig. 2: Methods of Preparation of TDDS

Asymmetric TPX Membrane Method:

The method was discovered in 1994 by Berners-Lee and John. It is possible to create a prototype patch using a 1cm-diameter concave backing membrane and a heat-sealable polyester film (type 1009, 3m). A drug-coated concave membrane sandwiched between asymmetric TPX [poly (4-methyl-1- pentene)] and adhesive [18].

Circular Teflon Mould Method:

Baker and Heller made the discovery back in 1989. Polymer solutions of varying concentrations are utilised as organic solvents. This splits the solution in half. The prescribed dose of medication is dissolved in one part, while the enhancers are dissolved in another part at varying

concentrations before the two portions are combined. The drug polymer solution is then diluted with a plasticizer (like Di-Nbutylphthalate). After 12 hours of stirring, the mixture is ready to be poured into a Teflon mould in the shape of a circle. Solvent vaporisation may be managed in a laminar flow hood model with a speed of 0.5 m/s by positioning the moulds on a flat surface and covering them with an inverted funnel. After 24 hours, the solvent has evaporated. After this, a dry film will have developed, which has to be kept for another 24 hours at 250.5°C in silica gel-filled desiccators before being evaluated[19].

Mercury Substrate Method:

Polymeric solution containing both drug and plasticizer. Once the mixture has been stirred for 10 to 15 minutes, it is transferred to a flat surface of mercury and covered with an inverted funnel to slow the rate at which the solvent evaporates [20].

By Using "IPM Membranes" Method:

A magnetic stirrer is used for 12 hours to mix the drug with water and polymer (propylene glycol containing Carbomer 940 polymer). Adding triethanolamine will neutralise the dispersion and increase its viscosity. Solution gel is formed by adding Buffer pH 7.4 to aqueous solutions of drugs that are poorly soluble in water. As the gel hardens, it will be integrated into the IPM membrane[21].

By Using "EVAC Membranes" Method:

TDS preparation necessitates a rate control membrane, and we recommend polyethelene (PE), ethylene vinyl acetate copolymer (EVAC) membrane with a carbopol reservoir gel concentration of 1%. If the drug is insoluble in water, a gel may be made of it using propylene glycol. Drug is dissolved in propylene glycol, which is then combined with carbopol resin and neutralised using a sodium hydroxide solution of 5% by weight. The treatment (in the form of a gel) is applied to a backing layer sheet that fully covers the affected area. Leak-proof apparatus will be achieved by covering the gel with a rate-controlling membrane and then sealing the edges with heat[22].

Preparation of TDDS by Using Proliposomes:

Proliposomes are produced via a film deposition technique, which is part of the carrier method. Based on the current research, a drug:lecithin ratio of 0.1:2.0 seems to be best. For each proliosome, you'll need 5mg of mannitol powder, a 100ml round bottom flask, 60–70 °C, 80–90 rpm of stirring speed, and 30 minutes of drying time in a vacuum. After drying, the water bath is typically cooled to between 20 and 30 degrees Celsius. The medication and lecithin are first dissolved in an appropriate organic solvent combination, and then a 0.5ml aliquot of the organic solution is added to the 37°C round bottomed flask. One 0.5 ml aliquot of the solution is added after the first has dried completely. Next, the flask containing the proliposomes is connected to a lyophilizer, and the mannitol powders (proliposomes) containing the medications are dried in a desiccator overnight before being sieved through 100 mesh. The powder is stored in a glass vial in the freezer until its composition can be determined [23].

By using Free Film Method: The initial step in this procedure involves casting a film that does not include cellulose acetate onto a surface of mercury. We use chloroform to make a polymer solution that is 2% w/w. The plasticizer addition rate is 40 percent weight-per-weight (w/w) of polymer. The mercury surface in a glass petridish is then covered with 5 ml of polymer solution. By holding an inverted funnel over the petridish, you may regulate the pace at which the solvent evaporates. After the solvent has evaporated completely, the film creation may be seen on the mercury's surface. The dried film is going to be taken off and stored in a desiccator between wax paper sheets. We may use this technique to create films of varied thicknesses by controlling the concentration of the polymer solution [24].

FACTORS AFFECTING TRANSDERMAL PATCHES

The efficacy of transdermal patches may be influenced by a number of variables. Here are several examples:[25]

a. Physicochemical Properties

- Coefficient of partition
- length on the molecular scale
- Melting/Solubility Point
- Ionization

b. Physiological & Pathological Conditions of Skin

- The horny layer acts as a storage reservoir.
- A layer of fat

- Differences in skin moisture and temperature among regions
- Pathological skin injuries
- Metabolic activity in the skin
- the characteristics of the skin's barrier at the newborn and infant stages
- Protective barrier function in skin of advanced age
- Boosters of Penetration Used.

VARIOUS MARKETED PREPARATIONS OF TRANSDERMAL PATCHES

In today's market various preparation of transdermal patches available in market. Some of these are Nicotine, Fentanyl, Norelgostromin / Ethinyl Estradiol, Diclofenac diethylamine, Rigotine,Estradiol, Nicotine, Estradiol, Estradiol, Testosterone[26].

Table 1: Various marketed preparations of transdermal patches

S. no.	Brand Name	Drug	Manufacturer
1	Nicotinell[R]	Nicotine	Novartis
2	Matrifen[R]	Fentanyl	Nycomed
3	Ortho Evra™	Norelgostromin / Ethinyl Estradiol	Ortho-Mcneil
4	NuPatch 100	Diclofenac diethylamine	Zydus Cadila
5	Neupro[R]	Rigotine	UCB and Schwarz Pharm
6	Alora	Estradiol	TheraTech/Proctol and Gamble
7	Nicoderm[R]	Nicotine	Alza/GlaxoSmithKline
8	Estraderm	Estradiol	Alza/Novartis
9	Climara	Estradiol	3M Pharmaceuticals/Beriex Labs
10	Androderm	Tstosterone	TheraTech/ GlaxoSmithKline

CONCLUSION

Micro emulsions, Niosomes, and liposomes are just a few examples of the cutting edge drug delivery technologies that are on the horizon. The invention aims to enhance delivery of a medicine that is poorly soluble in the excipients often used in conventional formulations. Steroids, antifungals, antibacterials, interferons, methotrexate, and local anaesthetics are only some of the medications that might be used as delivery vehicles. A future expansion of the transdermal patch business is anticipated, and the industry has been expanding at a pace of 25 percent per year in recent years. As more transdermal drugs enter the market and innovative devices enter the market, this number will rise. The use of transdermal administration of analgesics is expected to grow as new and better methods are developed. Studies are being conducted to enhance reliability and performance. Practical considerations, such the patch wearer's experience, may be enhanced, and the drug's therapeutic window can be extended, thanks to the higher precision of the new delivery method. Mechanical energy may be used to enhance transdermal technology, which can then be used to increase drug flow over the skin by either modifying the skin barrier or raising the energy of the drug molecules. Following the development of iontophoresis-based patch technologies, researchers are now exploring other types of "active" transdermal technology for a variety of medications. These include sonophoresis (using low frequency ultrasonic energy to disturb the stratum corneum), thermal energy, and electroporation (using brief electrical pulses of high voltage to form transitory aqueous holes in the skin) (uses heat to make the skin more permeable and to increase the energy of drug molecules). Research on the use of magnetophoresis, the use of magnetic energy to stimulate transdermal drug transport, has been conducted. For both short-term and long-term pain relief, the transdermal patch may be an underappreciated option. We anticipate that the popularity and utility of this mode of drug administration will rise as its distribution is refined and its analgesic options expand. About 40% of the drug delivery candidate items now in clinical trials are connected to the transdermal or dermal system, making it the most successful inventive research topic in novel drug delivery systems. As an alternative to traditional methods of systemic drug administration, transdermal drug delivery systems (TDDS) have been developed.

Systemic drug administration via the skin has a number of benefits, including the maintenance of a constant drug level in blood plasma, a reduction in the number of side effects, an improvement in bioavailability by avoiding hepatic first-pass metabolism, and an increase in patient compliance with the treatment's drug regime. The skin has recently gained favour as the most secure entry point for drug administration due to its ability to provide a steady stream of medication to the bloodstream.

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CONFLICT OF INTEREST: Nil

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