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A REVIEW ON TRANSDERMAL DRUG DELIVERY SYSTEMS

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ABSTRACT
Transdermal drug delivery systems are used to apply medications topically.(1) A transdermal patch is an adhesive patch with a medication (drug) covering that is applied to the skin to gradually release a predetermined dosage of the medication (drug) into the bloodstream.[2].A temperature variation of 37 ± 1°C was used to dissolve the patch in phosphate buffer (pH 7.4).During the manufactured transdermal patch's in vitro penetration research, a time- dependent increase in drug release was observed.The transdermal patch was created using the solvent casting process, and using scanning electron microscopy (SEM), it was assessed for organoleptic distinctiveness, stratification, weight consistency, flipping fortitude, dampness content, drug content, and external appearance. The Franz diffusion cell was used to perform in-vitro release kinetics, and the egg's outer membrane served as a barrier membrane.[3]
Keywords: *Transdermal Drug Delivery System, Herbal Patches, Marketed Transdermal Patches, Types Of Patches*

REVIEW OF LITERATURE

1) Chetan Ghulaxe et.al (1)-Drugs are applied topically using transdermal drug delivery methods. Pharmaceutical preparations known as transdermal patches come in different sizes and include one or more active ingredients. They are designed to be placed to intact skin to transport the active ingredient to the systemic circulation after it has passed through the skin's barriers and prevent first pass effects. Transdermal drug delivery has an advantage over other forms of medication delivery, such as oral, topical, intravenous, intramuscular, etc., in that the patch allows for a controlled release of the medication into the patient. This is typically accomplished by either body heat melting thin layers of medication embedded in the adhesive or by a porous membrane covering a reservoir of medication. Formulating transdermal films using herbal medicinal components was the goal of the current study.

2) SONIA DHIMAN et.al(4)-To get around the challenges of oral medicine delivery, the transdermal drug delivery method was developed. Transdermal patches are medicinal adhesive patches applied to the skin that allow a prescribed dosage to enter the bloodstream through the skin. This frequently aids in the recovery of a damaged bodily part. The patch offers a

controlled release of the medication into the patient, typically through a porous membrane covering a reservoir of medication or through body heat melting thin layers of medication embedded in the adhesive. This is one advantage of a transdermal drug delivery route over other forms of medication delivery, such as oral, topical, intravenous, intramuscular, etc.

3) Sakalle Parivesh1 et.al (7)- One essential component of innovative drug delivery systems is the transdermal drug delivery system (TDDS). All topically applied medication formulations meant to release the active ingredient into the bloodstream are collectively referred to as transdermal delivery systems. Polymeric formulations known as transdermal drug delivery systems apply the medication to the skin at a specific rate through the dermis to produce systemic effects. Despite being more expensive than traditional formulations, transdermal dosage forms are gaining popularity due to their special benefits. Potential benefits of transdermal medication delivery include controlled absorption, more consistent plasma levels, enhanced bioavailability, fewer adverse effects, easy and painless application, and the ability to stop drug administration by simply removing the patch from the skin.

4).Swl, Bankim Chandra Nandy et.al (10)- The current advancement in transdermal drug delivery technology, which can serve as a metaphor for the investigation and creation of pharmaceutical dosage forms for transdermal drug delivery, is the main subject of this paper. By reducing the number and size of doses required to accomplish the goal of systemic medication through topical application to the intact skin surface, TDDS (transdermal drug delivery system) improves drug safety and beneficial value by further determining the way and temporal position in the body. Compared to conventional drug delivery methods, TDDS offers numerous benefits. The transdermal route or therapy is non-invasive and has a stable medication plasma concentration, good bioavailability, and no first pass metabolism effect.

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INTRODUCTION

A transdermal patch is used to deliver a specific dosage of medication through the skin and into the bloodstream. In 1981, the FDA approved transdermal patch products for the first time. There are currently transdermal delivery systems that contain nicotine to help people quit smoking, fentanyl for chronic pain, clonidine and nitroglycerin for cardiovascular illness, and scopolamine (hyoscine) for motion sickness.[4]

A variety of permeation enhancer materials can be used to modify transdermal drug delivery systems, allowing for predictable control of the drug absorption profile. Different transdermal drug delivery systems, including vapour patches, membrane-moderated transdermal systems, matrix systems with drug-in-adhesive or matrix-dispersion systems, and single or multilayer drugs in the adhesive system, have different mechanisms to regulate the drug release rate. As a result, a brief discussion of the different kinds of transdermal patches is included in this review.accessible on the market with FDA approval, including their structural elements, physicochemical properties of the ingredients, designs, preparation techniques, polymeric matrix components, and different evaluation techniques needed for the evaluation.s. Below is a description of FDA-approved transdermal patches that are currently on the market available on the market with FDA approval, including their designs, preparation methods, polymeric matrix components, structural components, physicochemical characteristics of the constituents, and various evaluation procedures required for the assessments. The FDA-approved transdermal patches that are presently available for purchase are described below [5].

Fig.No 1

Transdermal Patches

Single-layer Drug-in-Adhesive

The incorporation of the drug directly within the skin-contacting adhesive is what distinguishes the single-layer drug-in-adhesive system. This transdermal system design uses an adhesive to both adhere the system to the skin and serve as the basis for the formulation, keeping the medication and all of the excipients together under a single backing film.

Multi-layer Drugs-in-Adhesive

Multi-layer Adhesive Drug Similar to single-layer drug-in-adhesive, multi-layer drug-in-adhesive incorporates the drug directly into the adhesive. Multiple drug-in-adhesive layers under a single backing film or the insertion of a membrane between two separate drug-in-adhesive layers are both included in the multi-layer concept, though [7].

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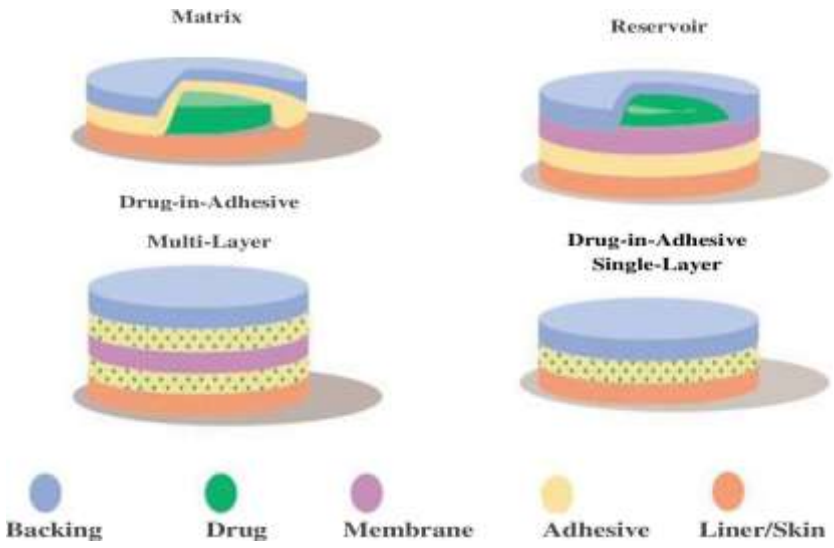

Fig.No 2[8]

Transdermal Patches

In order to administer a precise dosage of medication through the skin and into thebloodstream with a predetermined rate of release to reach the body, a transdermal patch is an adhesive medicated patch applied to the skin above. The most widely used transdermal technology on the market today is mostly based on semi-permeable membranes, sometimes referred to as patches. Often referred to as "transdermal patches" or "skin patches,"transdermal drug delivery systems (TDDS) are dosage forms intended to administer a therapeutically effective dosage of medication through a patient's skin and into their bloodstream.

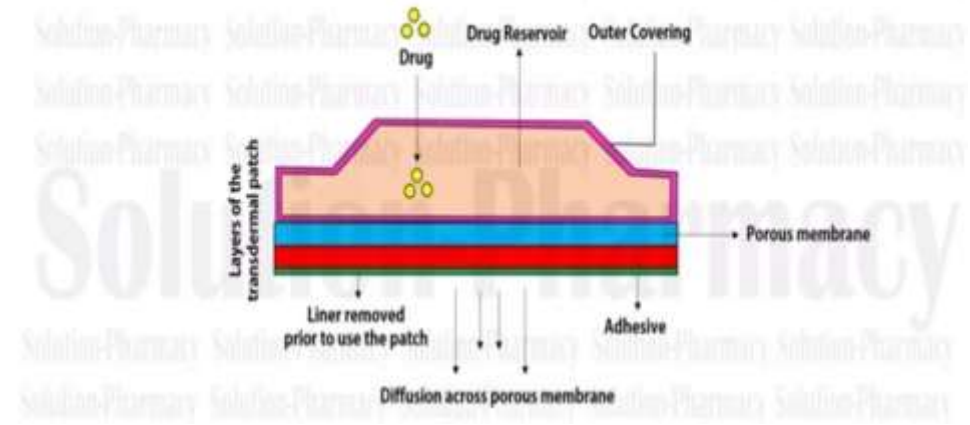

Fig.No 3[9]

MAIN INGREDIENTS USED FOR THE PREPARATION Of TRANSDERMAL DRUG DELIVERY SYSTEM

Liners: These shield patches while they are being stored, and they should be taken out before usage.

Adhesive: It was used to both stick the patch to the skin and hold its constituent parts together.

Membrane: It regulates how much medication is released from the multilayered patches. It is also known as the permeation enhancer. The drug reservoir and the release liner are in close touch.

Backing: this shields the patches from the outside world.[10]

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Advantages Of TDDS

1. Easy to use
2. Avoid GIT absorption problem for drug
3. More improved and convenient patient compliance
4. Rapid termination in case of toxicity is possible
5. Self medication is possible
6. Reduce frequency of dosing
7. Maintain therapeutic level for 1-7 days

Disadvantages of TDDS

1. Daily dose of more than 10 mg is not possible
2. Local irritation is a major problem
3. Drug requiring high blood levels are unsuitable 4.uncomfortable to wear
5. may not be economical
6. Heat, cold , sweating and showering prevent the patch from sticking

to the surface of the skin for more than one day .A new patch has to be applied daily

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Evaluation Method

Physicochemical, in vitro, and in vivo evaluation are the three categories into which the evaluation techniques for transdermal dosage forms fall.

1. Physicochemical Evaluation -

A. Interaction studies: To create a stable product, the medicine and the excipients must work well together. The drug's stability and bioavailability are impacted by interactions with excipients. Compatibility studies are crucial to formulation development if the excipients are novel and haven't been used in formulations with the active ingredient. By comparing their physicochemical characteristics, such as assay, melting point, wave numbers, and absorption maxima, thermal analysis, Fourier transform infrared spectroscopy (FTIR), ultraviolet (UV), and chromatographic techniques are used to extract interaction studies (Allen et al., 2005; Aarti et al., 1995; Lec et al., 1991).(13)

B. Patch thickness: To guarantee the thickness of the prepared patch 37, the thickness of the drug-made patch is measured using a digital micrometer at several points on the patch. Next, the standard deviation and average thickness are computed.(14)

C. Weight uniformity: Prior to testing, the produced patches must be dried for four hours at 60°C. A predetermined patch area must be divided into various sections and weighed using a digital scale. The individual weights must be used to compute the average weight and standard deviation values (Reddy et al., 2003).(13)

D. Shear Adhesion Test: This test is used to determine an adhesive polymer's cohesive strength. The molecular weight, the degree of cross-linking, the type and content of the polymer, and the quantity of tackifier supplied can all have an impact. A stainless steel plate is covered with adhesive-coated tape, and to make the tape pull parallel to the plate, a certain weight is suspended from it. The time it takes to remove the tape from the plate is used to calculate the shear adhesion strength. The shear strength increases as removal time increases.(14)

E. Skin Irritation study13: Healthy rabbits (average weight 1.2 to 1.5 kg) can be used for skin irritation and sensitization testingThe rabbit's dorsal surface (50 cm2) should be cleaned. Hair should be shaved from the clean dorsal area, and the surface should be cleaned with rectified spirit and representative formulations applied to the skin. After 24 hours, the patch must be taken off, and the skin must be examined and categorized into five grades according to the extent of the skin damage.(15)

2. In Vitro Assessment

In vitro research on medication release

The paddle over disc method (USP equipment) can be used to assess the drug release from the generated patches. Dry films of a given thickness must be cut into precise shapes, weighed, and adhered to a glass plate..After that, the apparatus was equilibrated to 32± 0.5°C and the glass plate was submerged in 500 mL of the phosphate buffer or dissolving media (pH 7.4). After that, the paddle was positioned 2.5 cm away from the glass plate and ran at 50 rpm. 5-ml aliquots of samples can be taken out at suitable intervals for up to 24 hours and subjected to HPLC or UV spectrophotometer analysis. Three duplicates of the experiment must be carried out in order to calculate the mean value.

Studies on in vitro skin penetration

Diffusion cells can be used to conduct an in vitro skin penetration research. Male Wistar rats weighing between 200 and 250 grams have full thickness abdomen skin.The dermal side of the skin was cleaned with distilled water to get rid of any blood vessels or adhering tissues before the experiment started. It was then equilibrated in phosphate buffer pH 7.4 or dissolution medium for an hour and put on a magnetic stirrer with a tiny magnetic needle to ensure that the diffusant was distributed evenly. Carefully use an electric clipper to trim any hair from the stomach area. The cell was kept at 32 ± 0.5°C using a thermostatically regulated heater. Place the isolated rat skin piece in the donor compartment, face up, between the sections of the diffusion cell.t. At regular intervals, a specific volume of the sample must be taken out of the receptor compartment and replaced with an equivalent volume of new medium. After passing through a filtering media, samples can be examined using HPLC or spectrophotometry. By dividing the flux by the initial drug load (mg cm2), the permeability coefficients and the slope of the curve between the steady-state values of the amount of drug penetrated (mg cm2) vs. time in hours can be directly calculated (16).

3. In vivo Evaluation:

The best way to portray the effectiveness of a medicine is through in vivo evaluation. In vivo investigations allow for a thorough exploration of the variables that are not possible to consider in vitro. Human volunteers and animal models can be used to evaluate TDDS in vivo.

1. Animal models: Small-scale animal research is favored since human studies take a lot of time and money to complete. Animals such as mice, hairless rats, dogs, guinea pigs, rabbits, and hairless rhesus monkeys are frequently used to test transdermal drug delivery systems. We have concluded from a variety of investigations that both in vitro and in vivo studies favor hairless animals over hairy ones.

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2. Human models: After applying the patch to human volunteers, pharmacokinetic and pharmacodynamic data are gathered as the last step in the development of a transdermal device. To evaluate the effectiveness, associated risks, adverse effects, patient compliance, etc., clinical trials have been carried out. Safety among volunteers is the primary goal of phase I clinical trials, while short-term safety and efficacy in patients are the primary goals of phase II clinical trials. Phase IV trials are conducted for commercialized patches during post-marketing surveillance to identify adverse medication reactions, while phase III trials show safety and efficacy in a wide patient population. Even though they cost a lot of money, human studies are the most effective way to evaluate a drug's effectiveness.(14)

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