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"WEARABLE WELLNESS A CLOSER LOOK AT TRANSDERMAL PATCHES"

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ABSTRACT:

Transdermal patches have become as a popular method of drug delivery because they are non-invasive nature and having ability to provide sustained delivery of drug. This is an adhesive patch means a substance that sticks things together designed to deliver a specific dose of medication through the skin and into the body's systemic circulation. Key components of transdermal patches, such as the backing layer, drug reservoir, rate- controlling membrane, and release liner with their roles in ensuring optimal drug delivery. Various factors that influence drug permeation through the skin have been studied, including drug physicochemical properties, skin physiology, and patch formulation are examined. Additionally, advances in patch technology such as microneedle patches and iontophoresis are being investigated for their potential to improve drug delivery efficacy. Transdermal patches offer many benefits, such as improved patient compliance, avoided first pass metabolism, and made it more convenient to use. Transdermal patches represent a promising avenue for enhancing therapeutic outcomes while minimizing systemic side effects, thereby offering significant potential for future drug development and clinical practice.

Keywords: Transdermal Patch, Drug Delivery, Skin, Adhesive Patch, Blood stream.

1. INTRODUCTION:

The goal of all pharmaceutical researcher and the industry is to develop a medication or drug delivery system that is both safe and effective [1]. Transdermal route of drug delivery can attain the local and systemic therapeutic effects [2]. Transdermal drug delivery offers the continuous, controlled doses of medication over time, bypassing the digestive system and avoiding liver metabolism or first pass metabolism resulting in improved bioavailability, convenient for use and reduced risk of gastrointestinal adverse effects [3]. Transdermal patches deliver medication directly through the skin, offering a convenient and non-invasive treatment option. They come in various sizes and contain multiple ingredients, providing sustained release into the bloodstream over several days. This delivery method allows for high doses of medication to remain on the skin for an extended period [4]. The best-selling of the transdermal patches in united state was the nicotine to help with cessation of tobacco smoking. The nicotine patch, release nicotine over sixteen hours, continuously Suppressing the smokers craving for cigarette. The scopolamine patch is worn behind the Ear and release the alkaloid for three days, preventing motion sickness without the need to Swallow tablets periodically. The fentanyl patch acts for the seventy-two hours, providing Long lasting pain relief. The first commercially available transdermal patch is the vapour patches, this vapour patches was first approved by Europe in 2007 to reduce smoking [5]. The FDA approved the first transdermal patch products in the field of drug delivery, this delivery system allowed for controlling systemic absorption of specific drugs The scopolamine was used for preventing motion sickness with a product called as "Transderm Scope." The nitro-glycerine was used for preventing angina pectoris associated with coronary artery disease with a product called "Transderm-Nitro" [6]. Transdermal patches have gained widespread acceptance due to their user-friendly nature, convenience, painless application, and ability to provide multi-

day dosing. Consequently, they are widely regarded as enhancing patient compliance with medication regimens. Projections suggest that the transdermal drug delivery systems market is poised for robust growth, with an anticipated annual increase of 12% by 2007, reflecting their growing the importance in the pharmaceutical industry [7].

2. STRUCTURE OF SKIN:

The skin consists of four layers: non-viable epidermis, viable epidermis, viable dermis, and hypodermis. The epidermis is the thin tough outer layer, the most visible and superficial layer of the skin containing keratinocytes derived from the basal layer. Keratinocytes slowly migrates towards the surface of the epidermis. The stratum corneum, outermost and waterproof, acts as a barrier against pathogens. It will provide strength and elasticity to the skin also keeps safe internal organs, muscles, nerves, and blood vessels. The viable epidermis, 50-100 µm thick, structurally resembles living tissues, with cells held by ton fibrils and 90% water content. The dermis, thick layer of fibrous and elastic tissue, Gives flexibility and strength. It containing nerve endings, sweat glands, oil glands, hair follicles, and blood vessels within loose, white, fibrous connective tissue containing blood and lymph vessels [8].

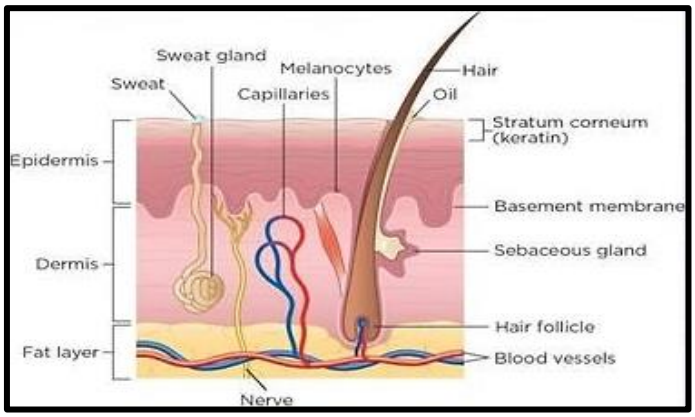

Fig 1: Structure of skin

3.TYPES OF TRANSDERMAL PATCHES:

There are mainly four types of transdermal patches is as follows:

3.1 Drug-in-Adhesive System: This is a basic form of membrane permeation control system where the adhesive layer contains drugs and adheres the layers together. The drug mixture is sandwiched between the liner and backing layers.

3.2 Resevior System: In this system drug reservoir situated between the backing layer and a microporous rate-controlling membrane. Drug release occurs through the pores of the membrane. The drug can be in various forms such as solution, suspension, gel, or dispersed within a solid polymer matrix within the reservoir chamber.

3.3 Matrix System: Drugs are evenly mixed into hydrophilic or lipophilic polymer matrices. These drug-polymer combinations are attached to discs with controlled thickness and surface area, creating drug-containing discs for targeted delivery.

3.4 Micro-Reservior System: This system combines reservoir and matrix dispersion methods. Initially, drug solids are suspended in an aqueous solution of a water-soluble liquid polymer. This solution is then uniformly dispersed within a lipophilic polymer, forming numerous non-leaching microscopic drug reservoirs [9].

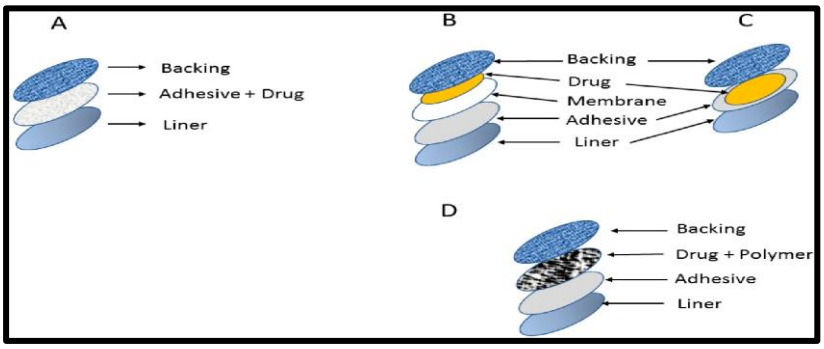

Fig 2: Types of Transdermal Patches

4. MECHANISM OF ACTION OF TRANSDERMAL PATCHES:

The transdermal patch is applied to the skin, and the active drug constituent gradually traverses through multiple pathways in the skin, eventually reaching the circulatory system by a variety of mechanisms:

4.1 Iontophoresis: This technique involves applying a low current on a small area of skin through an electrode which is placed in contact with the formulation to intensify drug delivery across the barrier. It is commonly used for delivering drugs like pilocarpine to induce sweating as a part of cystic fibrosis tests and lidocaine for rapid anaesthesia.

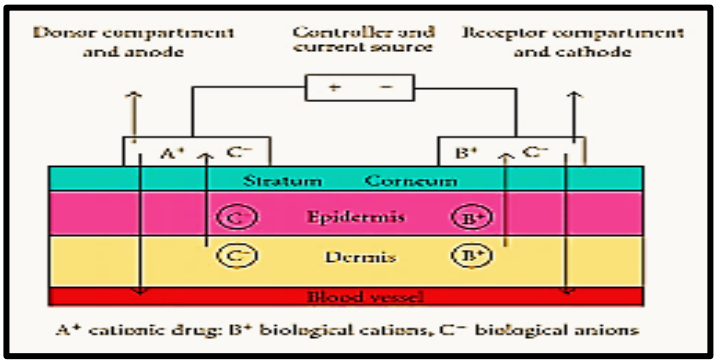

Fig 3: Iontophoresis

4.2 Electroporation: In this method applying short, high-voltage electrical pulses to the skin to significantly increase the permeability of the skin for drug diffusion is increase by 4 orders of magnitude. The electrical pulses create transient aqueous pores in the outer layer of the skin i.e. stratum corneum allowing for enhanced drug transport. It is a safe and can be administered painlessly using closely spaced electrodes to target the nerve-free outer skin layer.

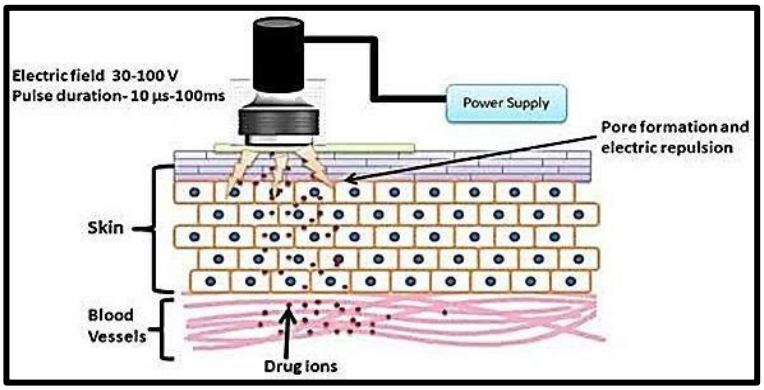

Fig 4: Electroporation

4.3 Application by Ultrasound: Ultrasound, involves particularly low-frequency ultrasound, is used to intensify the transdermal delivery of drugs, including larger molecules or macromolecule this process is also known as sonophoresis. Studies, The Katz et al., has reported its effectiveness in topically delivering medications such as the delivery of EMLA cream.

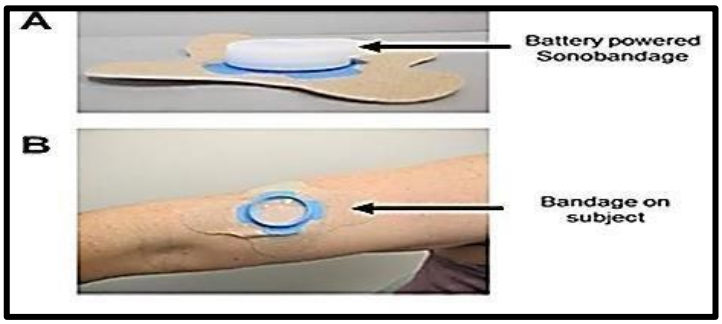

Fig 5: Application by Ultrasound

4.4 Use of Microscopic Projection: The transdermal patches with microscopic projections are called as microneedles used for transdermal drug delivery, it minimizing patient discomfortness in which needles ranging from about 10-100micrometer. They produce micro-punctures in the skin, enabling absorption of macromolecules or large molecule the drug is coated on the surface of microneedle for rapid absorption of drug into the bloodstream or systemic circulation. They are valuable contribution for skin vaccines like tetanus and influenza. It invovles Other methods used for transdermal patch like thermal poration, magnetophoretic, and photomechanical waves are also being explored for improved drug delivery [10].

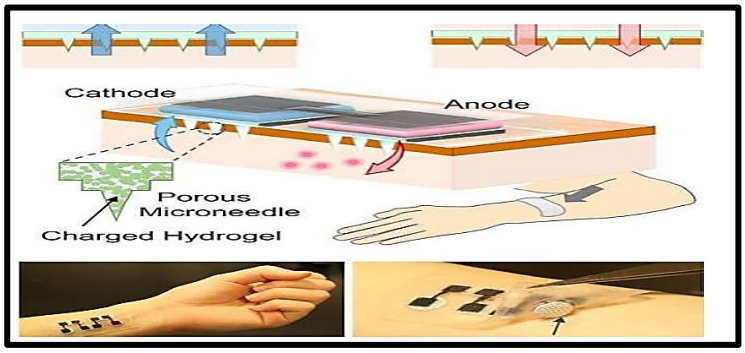

Fig 6: Use of Microscopic Projection

5. GENERAL METHOD OF PREPARATION OF TRANSDERMAL PATCHES:

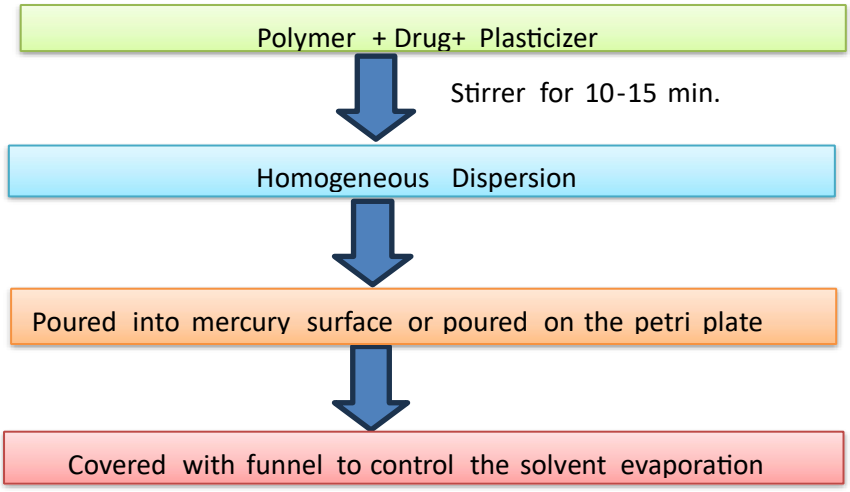

Fig 7: Preparation of Transdermal Patches

The patches are made up of by using the solvent casting process. Initially, The polymer (e.g., PVP/HPMC) was taken in a beaker prepared with least amount of solvent.Then 2/3 of solvent was mixed with additional polymers (e.g., PVA) were dissolved separately and combined gradually with stirring. The emollient was added and mixed homogenously and drug is incorporated with continued agitation and volume completed. Films was placed in a suitable designed glass mold and dried at 40°C. Films were removed, wrapped in parchment paper, and stored in a closed container away from light and in a cool place [11].

6. INSTRUCTION FOR APPLYING TRANSDERMAL PATCHES:

The Proper patch application and care plays important role for safe and effective drug delivery. Firstly, clean and dry the skin thoroughly before applying the patch avoids the cuts, irritation and rashes area to ensure optimal adhesion and drug absorption. Do not cut the patch, as it can distroyed the drug delivery.You make sure that Remove old patches completely before applying new ones to prevent interference. Be cautious while handling the patch, as medication can be absorbed through the skin. Always wash hands thoroughly after handling the patch. Precise placement is essential for therapeutic effect. Rotate application sites daily to prevent skin irritation and ensure consistent drug absorption. Follow the provided instructions carefully to minimize side effects and achieve the best results. the upper right arm on Day 1, upper right chest on Day 2, upper left chest on Day 3, and upper left arm on Day 4, then repeating the sequence to avoid the skin irritation [12].

Fig 8: Instructions for applying Transdermal Patches

7. TRANSDERMAL PATCHES AVAILABLE IN MARKET:

Year	Drug	Indication	Product Name	Marketing Company
1979	Scopolamine	Motion Sickness	Transderm-Scop	Novartis
1981	Nitroglycerin	Angina Pectoris	Transderm -Nitro	Novartis
1984	Clonidine	Hypertension	Catapres-TTS	Boehringer Ingelheim
1986	Estradiol	Menopausal symptoms	Estradarm	Janssen pharmaceutica
1990	Fentanyl	Chronic pain	Duragesic	Janssen pharmaceutica
1991	Nicotine	Smoking cessation	Nicoderm	GlaxoSmithKline
1998	Estradiol	Menopausal symptoms	Cobipath	Novertis
2003	Oxybutynyl	Overactive Bladder	Oxytrol	Watson pharma
2004	Lidocaine	Local derma anesthesia	Sonoprep	Endo therapeutics
2005	Lidocaine	Local derma anesthesia	Synera	Endo pharmaceuticals
2007	Rotigotine	Parkinson's disease	Neupro	Schwarz pharma
2007	Rivastigmine	Dementia	Exelon	Novartis [13].

Table 1: Drug product and clinical use of Transdermal Patches

CONCLUSION:

Transdermal patches is a valuable and effective method of drug delivery containing numerous benefits. It providing several advantages including steady, consistent dosage and potentially reduced side effect. It is beneficial for those patients who may have difficulty with the oral medication, which can lead to improved patient compliance.it also a painless drug delivery system, Patches can bypass the digestive system and first-pass metabolism to provide continuous dosing of drugs over an extended period of time. They are commonly used to deliver drugs for chronic pain, motion sickness, angina pectoris and many more. Transdermal patches remain a valuable option in modern healthcare, offering a reliable alternative to traditional oral or injectable forms of medication.

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