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Review: Topical Drug Delivery System

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ABSTRACT: Clinical evidence suggests that advanced gel is the safest and most effective treatment option for use in skin-related disease management and is used for internal measures to reduce side effects associated with other common dose forms. Advanced drug delivery systems include a large variety of drug dose forms such as semisolid, liability preparation, medication and solid powder. Many of the widely used semisolid preparations for distribution of advanced drugs include gels, creams and medicines. Gel is a polymer network connected to the inflammatory polymer in the middle of the fluid. Its assets rely greatly on the interaction between a solid government polymer and the lit part. Gel does not show the continuous flow of the government. The conversation between the breakdown of polymer sand livam forms a three-dimensional network interacting with scattered phase particles. The increase in maximumity due to the next interactive and next exodus is responsible for the semisolid state. Topical gel construction provides a good delivery system for drugs as they are less greasy and can be easily removed from the skin. Gel formulation provides excellent application assets and stability compared to creams and medicines.

Keywords: Topical, drug delivery, gels, drug delivery, organogels, Hydrogel.

I. INTRODUCTION

Topical drug delivery can be defined as application of drug via skin to directly treat or cure the skin disorders. These topical drug delivery systems are generally used for local skin infection like fungal infection or where other route of administration are no suitable.It can penetrate deeper into skin and hence give better absorption. Topical application has no of advantages over the conventional dosage forms. In general, they are deemed more effective less toxic than conventional formulations due to the bilayered composition and structure. In the formulation of topical dosage forms, attempts has being made to utilize drug carriers that ensure adequate localization or penetration of the drug within or through the skin in order to enhance the local and minimize the systemic effects, or to ensure adequate Percutaneous absorption.Topical preparation prevents the GI-irritation, prevent the metabolism of drug in the liver so as increase the bioavailability of the drug. Topical preparations give its action directly at the site of action. A gel is a two-component, cross linked three-dimensional network consisting of structural materials. The structural materials that form the gel network can be composed of inorganic particles or organic macromolecules, primarilypolymers.

U.S.P. defines gels as a semisolid system consisting of dispersion made up of either small inorganic particle or large organic molecule enclosing and interpenetrated by liquid. Gels consist of two phase system in which inorganic particles are not dissolved but merely dispersed throughout the continuous phase and large organic particles are dissolved in the continuous phase, randomly coiled in the flexible chains.

TOPICAL DRUG DELIVERY

Over the last decades the treatment of illness have been accomplished by administrating drugs to human body via various roots namely oral, sublingual ,rectal ,parental ,topical ,inhalation etc. Topical delivery can be defined as the application of a drug containing formulation to the skin to directly treat cutaneous disorder or the cutaneous manifestations of a general disease (eg:- psoriasis) with the intent ofcontaining the pharmacological or the effect of drug to the surface of the skin or within the skin semisolid formulations in all their diversity dominate the system for topical delivery , but foams, spray, medicated powders, solutions and even medicated adhesive systems are in use.

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Advantages

• Avoidance of first pass metabolism.
• Convenient and easy to apply.
• Avoid of risk.
• Inconveniences of intravenous therapy and of the varied conditions of absorption like Ph changes presence of enzymes gastric emptying time etc.
• Achievement of efficacy with lower total daily dosage of drug by continuous drug input.
• Avoid fluctuation of drug levels inter- and intra-patent variations.

Disadvantages

• Skin irritation of contact dermatitis may occur due to the drug and / excipients
• Poor permeability of some drugs through the skin
• Possibility of allergic reactions
• Can be used only for drugs which require very small plasma concentration for action
• Enzyme in epidermis may denature the drugs
• Drugs of larger particle size not easy to absorb through the skin.

Topical Drug Classification System (TCS)

Based on qualitative & quantitative composition,TCS provides a framework for classifying topicaldrug products. Topical drug products are classifiedinto 4 classes, as seen in Figure 1

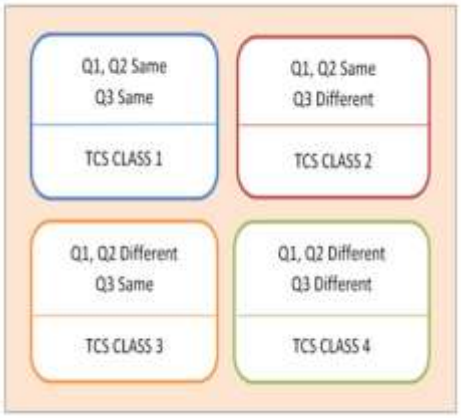

Figure 1: Classification of Topical DrugProducts Based on Qualitative & QuantitativeComposition

Anatomy of skin

Skin is the largest organ in the body. It consists of threelayers. The outer layer is called epidermis, the middlelayer is dermis and the inner most layer is hypodermis.

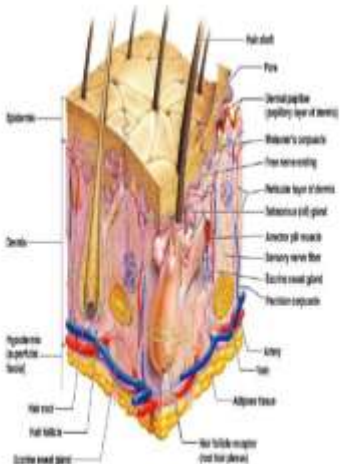

Fig No; 2 Anatomy of Skin

Epidermis:

Consists of epithelial cells. Among these cells,both living cells and dead cells can be found. These newcells at the bottom of epidermis divide fast and push theolder cells upward. The epidermis does not have anydirect source of blood veins to provide nutrition. It takesits nutrients from the diffusion of necessary moleculesfrom a rich vascular network in the underlying dermis.Epidermal cells are connected very strongly bydesmosomes. Desmosomes are in contact with theintracellular keratin filmates. Keratin filmates producekeratin. Keratin cells accumulate and crosslink with theother keratin cells in the cytosol during their maturation.Afterward when the older cells die, this network ofkeratin fibroses remains and provides a tough and hardprotective layer in epidermis, called protectivekeratinized layer.

Dermis:

Dermis is positioned under epidermis and ischaracterized by lots of elastin fibres that provide thestretching ability as well as lots of collagen that providesthe strength to the skin. Blood vessels found in dermisprovide nutrients for both dermis and epidermis. Dermisalso plays a major role in temperature regulation. Nervespresent there are responsible for pressure and painsensations. Dermis has a thickness of 3-5 mm. Inaddition to elastin fibres, blood vessels and nerves, aninterfibrillar gel of glycosaminoglycan, salt, water,lymphatic cells and sweet glands are parts of dermis.

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Hypodermis:

Hypodermis is the inner layer of skin. It isthe contact layer between skin and the underlying tissuesin body such as muscles and bone. Sweat glands,sebaceous glands and hair follicles enfold in epidermisbut they stem from dermis. Sweat glands release a dilutesalt solution into the surface of skin. The evaporation ofthis solution makes skin cool and this is important fortemperature regulation of both body and skin. Sweetglands are present all over the body. The amount ofdilutions (sweet) that gets produced depends onenvironmental temperature, the amount of heatgenerating skeletal muscle activity and various emotionalfactors. The sebaceous glands produce sebum. Sebumis an oily liquid released into hair follicles and from thereonto the skin surface. Sebum protects both hair and skinfrom drying out and provides waterproof layer.

CHALLENGES OF DEVELOPING TOPICAL DRUG DELIVERY SYSTEM

The challenge of developing a successful topicalproduct stems from the several requirements thata formulation must meet:

1. Container Selection and Product Stability

Depending on the properties of the combinedingredients, a dispensing container will be chosen(i.e., tube, jar, can, etc.) to provide a stablephysicochemical environment that protects theactive compound(s) from chemical degradation.The formulation can be a liquid or semi-solid,monophasic or multiphasic (e.g., oil-in-water orwater-in-oil); it is largely dependent on thecharacteristics of the active compound(s) and onthe condition of the skin to be treated.

2. Skin Penetration

Once the product is applied on the skin, acomplex interaction occurs between theformulation, the active compounds, and the skinitself. The penetration of the active compound(s)into the skin follows Fick's first law of diffusion,which describes the transfer rate of solutes as afunction of the concentration of the variousingredients, the size of the treatment surface area,and the permeability of the skin. However, theskin's permeability can be influenced by manyfactors, such as the drying, moisturizing, oroccluding effects of the excipients in the formulation, which, in combination, can modulatethe release of the product at the treatment site. Inacne, the site of action is inside the pilosebaceousunit and, therefore, an efficacious anti-acneformulation should facilitate the penetration ofthe active compound(s) into this extremelylipophilic environment.

3. Cosmetic Acceptability

In today's self-image conscious world, patientsare looking for topical products that are not onlysafe and effective, but also cosmeticallyacceptable and easy to apply. This is especiallytrue in acne, where the esthetic aspect is one ofthe primary reasons why patients seekdermatologic consultation. Moreover, acnepatients are mainly comprised of teenagers oryoung adults, and therefore, products that offerconvenience and are minimally disruptive to dailyroutines increase the level of compliance, andultimately, the efficacy of the topical therapy. Forexample, vehicle considerations for prescribingshould take into account the application of thedrug on large, hairy surfaces like the chest andthe back. This may require formulations thatspread easily, or in the case of facial acne, theideal formulation should leave minimal residue oroiliness.

ADVANCE IN TOPICAL DRUG DELIVERY SYSTEM

Following are the advances in the topical drugdelivery systems

Aerosol Foams:

The aerosol foams gained the increasinglypopular type of topical formulation for a varietyof skin conditions including acne vulgaris. Thevehicle base of the foam can have consistencylike liquid or semi-solid which shares equalphysicochemical characteristics of conventionalcarrier vehicle like gels, lotions and creams but itmaintains desirable properties such asmoisturizing, quicker drying effects, or highbioavailability of drug. The aerosol base isdispensed through a gas-pressurized can thatdischarges the foam. The product characteristicslike thickness, viscosity, texture, bubble size,density, persistence, stabile nature, and spreadability are determined by the type of formulationand the dispensing container that are selected tosuit the specific therapy needs. The foams maybe preferred for application on large hairysurfaces (e.g., chest and back) or on the face ascleansers, because they are easier to apply.

Liposomes:

The liposomes are artificially prepared vesiclesmade of lipid bilayer which are frequently

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usedas vehicles in pharmaceuticals and cosmetics fordrug delivery in controlled manner to particulararеas of skin or its layers. Liposomes arespherical vesicles whose membrane consists ofamphiphilic lipids this lipid that are hydrophilicon one side and lipophilic on the other side i.edual characteristics which enclose an aqueouscore, same as to the bilayer membranes of livingcells. Because liposomes offer an amphiphilicenvironment, they may encapsulate hydrophilicsubstances in their aqueous core and lipophilicsubstances in their lipid bilayer. This unique dualrelease capability enables the delivery of 2 typesof substances once they are applied on the skin;each differs in its effects on skin permeability,which may enhance the desired therapeuticbenefit.

Nanoemulsions:

Nanoemulsions are a class of emulsions whichmay be water-in-oil or oil-in-water type offormulations that are identified and characterizedby the dispersion of very small-sized dropletswhen mixed. The major requirement ofnanoemulsions unique thermodynamicconditions without the nanoemulsions will notformed spontaneously, as they require uniquethermodynamic conditions, specializedmanufacturing processes, and specific surfactantsthat can stabilize the nano droplets.Nanoemulsions are suitable for the transport oflipophilic compounds into the skin and,therefore, they may be an ideal vehicle for use inacne to increase the penetration of the activecompounds inside the lipophilic environment ofthe pilosebaceous unit. In addition,nanoemulsion particulates will not clog the poresand they can produce additional therapeuticeffects, such as increased skin hydration andviscoelasticity.

Polymers:

The polymers have played the milestonefunctioning in designing the topical formulation.The polymers are large molecules consisting ofrepeating structural units, or monomers that areconnected by covalent chemical bonds. Thesecompounds serve as the building blocks ofnatural like paper and amber, biological likeproteins and nucleic acid, synthetic in form ofplastics and polyethylene materials etc.Nowadays applications for synthetic polymerscan be found in nearly every industry, and theirversatility has given rise to technologicaladvancements within the pharmaceutical sectorthat address a variety of medical needs. Forexample, in dermatology, there are new acrylicacidpolymers that turn into a gel in the presenceof water by trapping water into microcells. Insidethese aqueous microcells, hydrophiliccompounds can remain in a solution, whereasnon-hydrophilic compounds may be dispersed insuspension. The result is a stable gel-likeformulation that is easy to use and releases theactive compound once they are applied on theskin. Moreover, these polymer-based gels can bemixed with other excipients, such as moisturizersand emollients, to provide additional clinicalbenefits. Recently introduced anti-acneformulations that combine clindamycin 1% withbenzoyl peroxide 5% (Duac®, StiefelLaboratories; BenzaClin®, Dermik) utilize thisnovel polymer-based gel technology that exhibitsefficacy and excellent tolerability.following isthe on of the polymer type used in topicalformulation has wide application in thedesigning the advance formulation for skindelivery.

II. CONCLUSION:

Thecurrentreviewconcludestoshowthatnewandalternativedrugdispensingsystemsarecurrentlyfocusedonvariousresearchactivities.Thedosagebasedapplicationsareimportantassafety,efficacyandconvenienceofuseforpatientfactorsthatneedtobeconsideredwhiledevelopingnoveloralternativedrugdeliverysystems.Inrecentyears,thetransdermalrouteofdrugdistributionhasevolvedconsiderablyandhasbeengrowingasaconvenientpropertiesalongwith topicalapplication.Mostdevice-inducedtransdermaldrugdeliverytechniquesarestillin the earlystagesofcommercializationtooptimizebetterdistributionofqualityproduct.

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