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A Review on Emulgel

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Abstract: *Topical drug delivery is the delivery of drugs anywhere in the body via skin, vaginal, ophthalmic and rectal routes. Pills may be given for localized or systemic results. Topical formulations with varying physicochemical homes, which includes solid, semisolid, or liquid, may be developed. The topical system is created by means of preparing a drug emulsion and incorporating it into an em. Emulgel is a thermodynamically strong method with low interfacial anxiety that is made through combining a surfactant and a co-surfactant and has numerous properties which include multiplied permeability and accurate thermodynamic stability. Emulgel has a twin control and a sustained release pattern. Emulgel improves bioavailability in addition to affected person compliance. The pH, viscosity, particle size, zeta capacity, drug content material, stability study, pores and skin inflammation test, and other properties of the organized formula are evaluated*

Keywords: Emulgel, Co-surfactant, Gelling agent, Surfactant, Topical drug delivery

I. INTRODUCTION

Topical drug shipping refers back to the utility of a drug-containing system to the skin to treat a cutaneous condition. This machine is used when different routes of drug management (including oral, sublingual, rectal, and parental) fail, or while a neighborhood pores and skin infection, along with a fungal infection, occurs. Topical drug management is a commonplace treatment technique for each neighborhood and systemic conditions. Inside the topical shipping machine, the drug is absorbed by way of the pores and skin and reaches the website of motion to offer a healing impact. The fee of drug launch from a topical education relies immediately at the physiological functions of the ser. The number one advantage of a topical transport system is that it avoids the first-skip metabolism. The term micro emulsion is based on particle length. Due to their smaller size, the drug debris can easily diffuse thru the pores and skin and reach their web page of action. The gel will hold the micro emulsion for a long time and will useful resource inside the sustained release of the drug. Various fungal infections are developing in recent times that are a primary problem for society. Fungal infections inclusive of Tinea capitis, Tinea pedis and Tinea corporis infect the pores and skin critically. A technique which includes emulgelcan aid in the easy penetration of the drug into the pores and skin and provide a rapid onset of action.

Many blessings of gels a primary hindrance is inside the shipping of hydrophobic capsules. So, to overcome this drawback an emulsion based totally approach is being used so that even a hydrophobic healing moiety can revel in the particular residences of gels. While gels and emulsions are used in mixed form the dosage shape are referred as emulgel. In recent years, there was remarkable hobby in the use of novel polymers. A completely unique thing of dermatological pharmacology is the direct accessibility of the pores and skin as a goal organ for diagnosis and remedy. The combination of hydrophilic cornified cells in hydrophobic intercellular cloth presents a barrier to each hydrophilic and hydrophobic materials. Inside the essential organization of semisolid arrangements, the use of transparent gels has extended both in cosmetics and in pharmaceutical preparations. Polymer can feature as emulsifiers and thickeners because the gelling potential of these compounds lets in the method of stable emulsions and lotions by lowering surface and interfacial anxiety and on the equal time increasing the viscosity of the aqueous segment. In truth, the presence of a gelling agent in the water segment converts a classical emulsion into an emulgel. Those emulgel are having primary advantages on novel vesicular systems in addition to on traditional structures in various elements. Numerous permeation enhancers can potentiate the impact; So emulgels may be used as higher topical drug transport systems over gift systems. Using emulgels can be extended in analgesics and antifungal drugs.

Topical drug management is a localized drug shipping gadget everywhere inside the frame through ophthalmic, rectal, vaginal and skin as topical routes. Those are observe a wide spectrum of arrangements for each cosmetic and

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dermatological, to their healthful or diseased skin.1 those formulations range in physicochemical nature from stable via semisolid to liquid. Drug substances are seldom administered on my own, however as a substitute as part of a method, in combination with one or greater non medicated marketers that serve various and specialized pharmaceutical characteristic. Drugs are administered topically for his or her motion at the site of utility or for systemic consequences. Drug absorption through the pores and skin is enhanced if the drug substance is in answer, if it has a beneficial lipid/water partition coefficient and if it is a nonelectrolyte. For the most element, pharmaceutical arrangements carried out to the pores and skin are supposed to serve a few neighborhood action and as such are formulated to provide prolonged nearby touch with minimum systemic drug absorption. Drug implemented to the skin for their neighborhood action include antiseptics, antifungal agent, skin emollients and protectant. The main advantages of topical delivery system are to pass first pass metabolism. Avoidance of the dangers and inconveniences of intravenous therapy and of the varied conditions of absorption like pH changes, presence of enzymes, gastric emptying time are other advantages of topical arrangements.

The topical drug delivery gadget is usually used where the others gadget of drug management fails or it's miles in particular used in fungal contamination. Hu guy skin is a uniquely engineered organ that perm its terrestrial lifestyles by way of regulating heat and water loss from the frame even as preventing the ingress of noxious chemical substances or microorganisms. it is al so the largest organ of the human body, providing around 10% of the body mass of a median man or woman, and it covers a mean location of 1.7 m2 . Whilst any such huge and easily on hand organ reputedly gives best and a couple of websites to manage healing retailers for each neighborhood and systemic movements, human skin is a especially efficient self-repairing barrier designed to hold the internal in and the out of doors out.5 Gels are an enormously more recent elegance of dosage shape created by way of entrapment of big amounts of aqueous or hydroalcoholic liquid in a network of colloidal solid debris, which may additionally consist of inorganic substances, including aluminum salts or natural polymers of herbal or artificial beginning. they have a better aqueous element that lets in more dissolution of medicine, and additionally allow clean migration of the drug via an automobile that is essentially a liquid, in comparison with the ointment or cream base. these are advanced in phrases of use and patient acceptability. No matter many blessings of gels a chief obstacle is inside the shipping of hydrophobic drugs. So to conquer this trouble, emulgels are prepared and used so that even a hydrophobic healing moiety can enjoy the specific homes of gels.

In reality, the presence of a gelling agent inside the water segment converts a classical emulsion into an emulgelboth oil- inwater and water-in-oil emulsions are used as vehicles to deliver various pills to the pores and skin. Emulgels for dermatological use have several favorable homes which include being thixotropic, greaseless, without difficulty spreadable, effortlessly detachable, emollient, no-staining, long shelf life, bio- pleasant, obvious & alluring appearance.

Use of topical seller’s calls for an appreciation of the factors that influence percutaneous absorption. Molecules can penetrate the pores and skin by way of three routes: thru intact stratum corneum, through sweat ducts, or via sebaceous follicle. The surface of the stratum corneum gives extra than 99% of the entire skin surface to be had for percutaneous drug absorption.

Passage thru this outer most layer is the rate limiting step for percutaneous absorption. The major steps concerned in percutaneous absorption consist of the establishment of a attention gradient, which offers the using force for drug motion throughout the pores and skin, release of drug from the car (partition coefficient), and drug diffusion throughout the layers of the pores and skin (diffusion coefficient). Ultimate traits of topical capsules consist of low molecular mass (600 Da), ok solubility in oil and water, and an excessive partition coefficient. Besides for very small debris, water soluble ions and polar molecules do no longer penetrate intact stratum corneum. Topical components can be used to manipulate the barrier function of the skin, for instance, topical antibiotics and antibacterial assist a damaged barrier closer to off infection, solar screening marketers and the horny layer defend the possible tissues from Ultraviolet radiation and emollient preparations repair pliability to a desiccated attractive layer.16For the duration of improvement of semi-solid preparations for cutaneous utility whose formula contains an antimicrobial preservative, the need for and the efficacy of the chosen preservative will be validated to the satisfaction of the equipped authority. An appropriate check method collectively with criteria for judging the preservative houses of the components are furnished in efficacy of antimicrobial maintenance. Sterile semi-strong preparations for cutaneous software are prepared the use of materials

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and techniques designed to make certain sterility and to avoid the advent of contaminants and the growth of microorganisms.

The efficacy of an antimicrobial preservative can be more advantageous or faded by means of the energetic constituent of the education or by using the system wherein it is included or by the field and closure used. Preparation for topical use should have microbiological fine and its miles checked with test for sterility. Overall possible aerobic depend ought to now not be more than 102 micro-organisms (cardio bacteria plus fungi) according to gram. It must now not have more than 101 enter bacteria, sure different gram-bad bacteria per gram and absolutely without Pseudomonas aeruginosa and Staphylococcus aureus.

Need of Emulgel:

Many widely used topical sellers like ointment, cream, lotion have many negative aspects. They have very sticky inflicting uneasiness to the affected person when carried out. Moreover additionally they have lesser spreading coefficient and need to use with rubbing. And they showcase the problem of balance also. Due to these kinds of elements inside the most important organization of semisolid arrangements, the usage of obvious gels has accelerated each in cosmetics and in pharmaceutical arrangements.

A gel is colloid that is generally 99% wt. liquid, that's immobilized via surface anxiety among it and a macromolecular community of fibers constructed from a small quantity of a gelatin substance gift. Despite many advantages of gels a chief limitation is in the transport of hydrophobic drugs. So to triumph over this difficulty an emulsion primarily based approach is getting used in order that even a hydrophobic therapeutic moiety may be efficiently integrated and added via gels.

Emulsion

Emulsions are made by combining two or more liquids that are normally incompatible. In this system, the oil phase is miscible with the aqueous phase using an emulsifying agent. The use of emulsifying agents helps to stabilize emulsions. They are easy to wash off and they also penetrate well

Gel

word “gel” refers to enhancing the viscosity of liquid preparations without changing other properties. Gels can be used as a thickening agent and also help to improve the homogeneity and consistency of a formulation. This agent is used to create a gel base, which is then mixed with emulsion to create emulgel. A gel is made up of a polymer that enlarges when exposed to fluid and possibly within its structure. The amount of fluid entrapped in the gel determines its rigidity. These gels are wet and smooth, with the appearance of being solid. These are capable of significant physical deformation, from solid-state to liquid state .

Introduction to Emulgel

Emulgel is known as an emulsion that has been gelled by using a gelling agent. They can be made either o/w or w/o type. Emulgel is a stable and superior system that incorporates poor water-soluble drugs. In brief, emulgel is a combination of emulsion and gel. Despite the numerous advantages of gels, one significant disadvantage is the delivery of hydrophobic medications. As a result, an emulsion-based solution is being used to overcome this limitation, allowing even hydrophobic therapeutic moieties to benefit from the unique properties of the gel.[1]

$$\text{Emulgel system} \Longrightarrow \text{Emulsion} + \text{gel}$$

INTRODUCTION OF EMULSION

An emulsion is a two phase system consists two completely immiscible liquid one of which is dispersed as fine globules into others.Emulsion is biphasic system prepared by combining two immiscible liquid.

- DISPERSED PHASE: - It is also known as dispersed phase/internal phase. The phase which is dispersed into dispersion medium is known as dispersed phase.

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• DISPERSIONMEDIUM: - It is also known as continuous phase/external phase in which the dispersion medium is dispersed is known as dispersion medium.

It is thermodynamically unstable system which can be stabilized by the presence of an emulsifying agent (emulsifier).Emulsifying agent is an intermediate or interphase between two dispersion phase or dispersion medium system. In Pharmaceutical practical the emulsion is used for liquid preparation for oral use. Emulsion is also used for external use is referred to lotion or liniments. The particle size of globules is ranging from 0.1 to 100 micrometer. System of at least two immiscible phases are called dispersion. A disperse system is made of a dispersed phase in a continuous flow.

There are three major types of dispersions based on the physics of dispersed phase, namely the following: foam of a gas in a liquid mixture; suspensions of a solid in a liquid blend; as well as emulsion of a liquid in a liquid system. Emulsion is a mixture of two immiscible liquids, which generally forms during various chemical processes/equipment such as water flooding of heavy oil reservoirs, water treatment membranes, and packed bed separators. For instance, emulsions can be categorized as water-in-oil emulsion (with water droplets as a dispersed phase in the flow of oil as the continuous phase), oil-in-water emulsions (with oil droplets in the flow of water), and more complex configurations of emulsions such as water-in-oil-inwater, Oil-in-water-in-oil emulsions.Crude oil is blend of hydrocarbons with different sizes that can have various applications in the chemical and energy industries. The type and composition of crude oils (as vital factors) play important roles in the development of emulsions. Water-in crude oil emulsions are stable in the dispersions of water droplets in a continuous flow of oil, stabilized by heavy particles/components (naturally occurring emulsifiers) present in the oil. Emulsion formation is a recurring issue that is undesirable in the oil industry as it might cause flow blockage, inefficient separation, operational problems, corrosion, and consequently, adding high costs to the transportation, processing, and separation units.For instance, the dispersed water droplets occupy a considerable volume of the processing facilities and pipelines, VOLUME 97, JANUARY 2019 Leading to appreciable variations in the normal operating conditions and an increase in operational expenses. Furthermore, the physical properties of oil are significantly altered owing to the presence of emulsions.

TYPES OF EMULSION:-

1) Primary emulsion containing one internal phase, for example

a) Water in oil emulsion (w/o):-

b) Oil in water emulsion (o/w):-

2) Secondary emulsion also known as multiple emulsion contain two internal phases for instances, multiple emulsions are water-in-oil-in-water (w\o\w) or oil-in-water-in-oil (o\w\o)

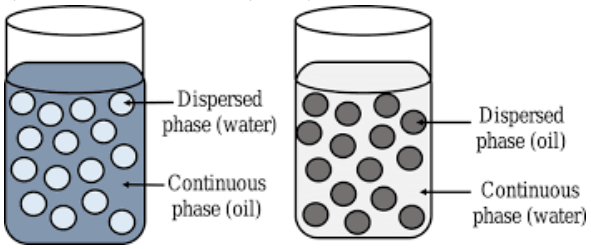

Fig. no 1

Identification Tests for Emulsion:-

1) Dilution test :-

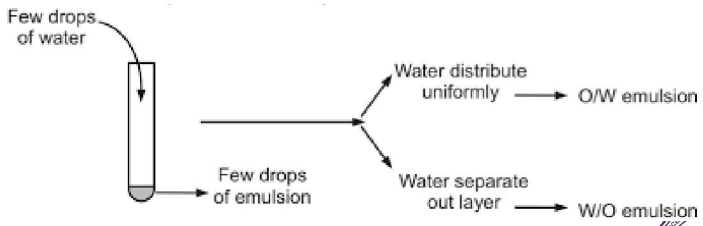

Fig no.2

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The addition of water to w/o emulsion and oil to o/w emulsion leads to cracking of emulsion and also leads to separation of the phases and dilution of emulsion.

2) Conductivity test :-

Water is a good conductor of electricity where as oil is an non conductor of electricity the conductivity test can be performed by dipping a pair of electrodes connected to a low voltage bulb which glows on passing the electric current through the emulsion o/w type due to presence of water in continuous phase but in case of w/o type the bulb doesn't glow because the oil is present in the continuous phase

i.e- o/w = current flow

w/o = current do not flow

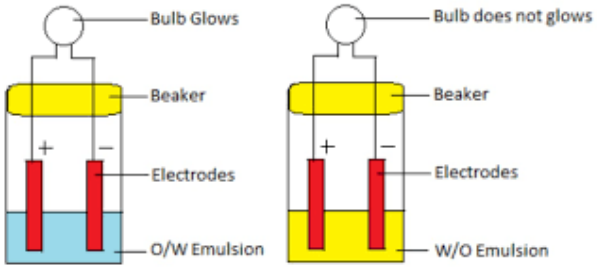

fig no-3 Conductivity test diagram

3) Dye test :-

The water soluble dye will dissolve in aqueous phase (water) where as oil-soluble dye will dissolve in the oily phase (oil) for e.g. amaranth solution used for o/w emulsion, scarlet/sedan used for w/o emulsion

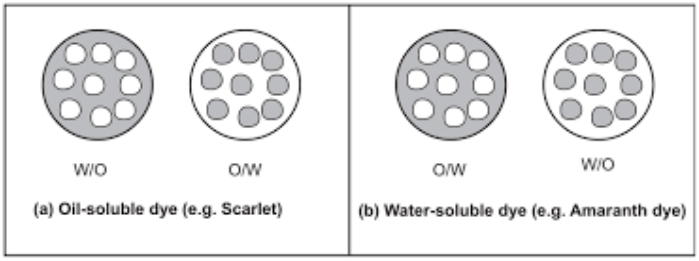

Fig no-4

4) Fluorescent test :- Oil has an capability to absorb the UV light and gives fluorescence while water does not gives the fluorescence. Hence, o/w emulsion shows spotty pattern while w/o emulsion fluorescence.

5) Cobalt chloride test :- Cobalt chloride is water soluble substance. Small amount of cobalt chloride is add in unknown emulsion when the cobalt chloride is dissolve in the emulsion is o/w type because water is continuous.

Methods of preparation :-

1. Dry Gum Method :
2. Wet Gum Method :-
3. Bottle Method :

DRY GUM METHOD:

- Measure requires quantity oil.
- Calculated quantity of gum acacia add with rapid triturate.
- Add required quantity of water with rapid triturate until clicking sound occurs.
- Now the product becomes white or nearly white.
- Now the product called primary emulsion.
- Add more water to make required quantity.

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WET GUM METHOD:-

- Calculate the quantity of oil, water, gum.
- Gum acacia + water form mucilage.
- Add require quantity of oil in small portion with rapid trituration.
- Product becomes white and nearly white.
- Primary emulsion.
- Add more water in small portion with uniform trituration to produce final volume.

Stir thoroughly as to form a uniform emulsion.

BOTTLE METHOD:-

- It is only for volatile and non viscous oil.
- Measure quantity of oil and transfer into flask.
- Add gum acacia.
- Now shake the flask until the gum and oil mix properly.
- Add water.
- Shake the mix vigorously to form a primary emulsion.
- Add more water to make up the volume of emulsion.

FORMULATION OF EMULSION

1. Emulsifying agent
2. Preservatives
3. Antioxidants
4. Flavoring agent

EMULSIFYING AGENT:

There are larger number of emulsifying agent no single agent have all properties required so two or more emulsifying agent used to make stable emulsion.

IDEAL PROPERTIES OF EMULSIFYING AGENT

1. It should be capable of reducing interfacial tension it should be compatible with other ingredients.
2. It should be non toxic.
3. It should be chemically stable
4. It should be capable to reduce required consistency.

EMULSIFYING AGENTS:-

Natural
Vegetable source: Agar, Gum acacia, Pectin, Starch, Irishmoss.
Animal Source: Wolf fat, Egg yolk, Gelatin.
Semi synthetic Polysaccharide
Methyl Cellulose[2]

GEL

INTRODUCTION OF GEL

Topical gels are semi solid homogenous preparation used to cure and treat topical diseases. Gels are more hydrophilic in nature so the rate of released drug or active ingredient was fast. A gel consist of two component, three dimensional cross linked material which contain proportionally large amount of liquid medium to form adequate rigid network which immobilized the liquid continuous phase. Inorganic particles and organic macromolecules both are used to form a structural network of gel. In chemical gel the particles are associated with permanent covalent bonding while physical

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topical gels are associated by weaker and reversible secondary intermolecular forces like hydrogen bonding, electrostatic interactions, hydrophobic interaction and Vander Waals forces.

IDEAL PROPERTIES OF TOPICAL GEL

- The gel should be clear and homogenous.
- The gel should be easily broken when shear or force is applied during shaking the container.
- The gel should be inert in nature.
- The gel should be not sticky.
- The gel should be never interacting with other formulation component.
- The gel should be stable.
- It should not be irate the skin or any part where the gel is applied
- The viscosity is optimum.
- It should have anti- microbial activity

IDEAL CHARACTERISTICS OF GELS.

Swelling:- The gelling agent used to prepare gel are capable for swell the liquid when liquid medium comes to its contact. The swelling property of gel depends on gelling agent and its shows the strength and bonding of particle in the gel.

Syneresis:- Most of the gels released some water or liquid during standing and after days of storing the phenomenon of releasing fluids from gel is termed as syneresis. This show that the gel not has sufficient amount of gelling agent or the concentration of gelling agent decreases. It also shows that the formulation is thermodynamically unstable. The gel should be syneresis free.

Structure:- The gel rigidity is depend on the gelling agent. The selection of gelling agent is most important part of the formulation. The gelling agent is responsible for viscosity (resistance to flow) networking and bonding between particles and medium used in formulation. pH:- The pH of gel is to be isotonic. The fluctuation in the pH of gel may cause the skin irritation.

Spreadability:- The spreading power of gel should be excellent. It indicates the area covered by gel.

METHOD FOR PREPARATION OF GEL

There are 3 methods for preparation of gels

1. Fusion method:- In this method the vehicles, gelling agents, additives and drug are blended at high temperature to until a semi solid texture was not formed.
2. Cold method:- In this method all the component exclude drug or active pharmaceutical ingredient is heated and blended simultaneously and then lower the temperature of formulation, then add drug and again blending was started until the gel was not formed.
3. Dispersion method:- In this method the gelling agent is stirred with water until the gelling agent is swell up and then drug is dissolved in medium and incorporated into it. Add buffer solution to adjust the pH of the gel if necessary.

GELLING AGENT:-

Gelling agents are the polymers that are used to structural network or provide texture to the gels. Gelling agents are classified as follows:-

Natural:- Gelatin, Xanthine, Cassia Tora, collagen, pectin and Guar gum etc. Synthetic:- Carbopol 934, Carbopol 940, Polaxamers and Polyvinyl Alcohol etc.

Semi synthetic:- Hydroxypropyl methyl cellulose, Carboxyl methyl Cellulose and Hyroxylethyl Cellulose.

ADDITIVES USED IN GEL FORMULATION

Preservative:- Preservatives are used to make the gel long lasting and prevent them to spoil .E.g., Methyl Paraben and Propyl Paraben etc

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Drug solubilizer:- Drug solubilizer is used in the case of drug having poor solubility. Some drugs are poorly soluble in medium so drug solubilizer helps to dissolve the drug in the medium. E.g., Triethyl-o-amine and PVP (Polyvinylpyrolidine) etc. Stabilizers:- Some gels containing heavy metals and agents which is stabilized by chelating agent, such as E.D.T.A.(Ethlylene diamine tetra acetic acid.[3]

RATIONALE

Many widely used topical agents like ointment, cream, lotion have many disadvantages. They have very sticky causing uneasiness to the patient when applied. Moreover they also have lesser spreading coefficient and need to apply with rubbing . And they exhibit the problem of stability also. Due to all these factors within the major group of semisolid preparations, the use of transparent gels has expanded both in cosmetics and in pharmaceutical preparations. A gel is colloid that is typically 99% wt liquid, which is immobilized by surface tension between it and a macromolecular network of fibers built from a small amount of a gelating substance present. In spite of many advantages of gels a major limitation is in the delivery of hydrophobic drugs. So to overcome this limitation an emulsion based approach is being used so that even a hydrophobic therapeutic moiety can be successfully incorporated and delivered through gels.[4]

ADVANTAGES AND DISADVANTAGES OF EMULGEL

ADVANTAGES

- Incorporation of hydrophobic drugs
- Better loading capacity
- Better stability
- Controlled release
- No intensive sonication
- Avoiding first pass metabolism
- Avoiding gastrointestinal incompatibility
- More selective for a specific site
- Improved patient compliance
- Convenient and easy to apply

DISADVANTAGES

- Skin irritation on contact dermatitis
- The possibility of allergenic reactions
- The poor permeability of some drugs through the skin
- Drugs of large particle size are not easy to absorb through the skin
- The occurrence of the bubble during formulation of emulgel.[5]

Structure of Gels

The rigidity of a gel arises from the presence of a network formed by the interlinking of particles gelling agent. The nature of the particles and the type of force that is responsible for the linkages, which determines the structure of the network and the properties of the gel.

The individual particles of the hydrophilic colloid may consist of either spherical or an isometric aggregate of small molecules, or single macromolecules. Possible arrangements of such particles in a gel network are shown in. In linear macromolecules the network is comprised of entangled molecules, the point of contact between which may either be relatively small or consist of several molecules aligned in a crystalline order, as shown in Figure 1 (c) and (d), respectively.

The forces of attraction responsible for the linkage between gelling agent particles may range from strong primary valencies, as in silicic acid gels, to weaker hydrogen bonds and Vander Waals forces. The weaker nature of these latter forces is indicated by the fact that a slight increase in temperature often causes liquefaction of gel.

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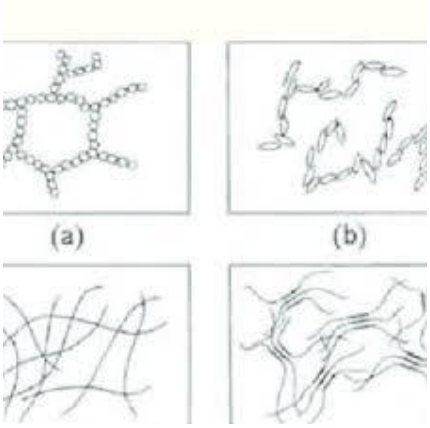

Figure5 : Representations of gel structures. (a) Flocculated particles in a two-phase gel structure. (b) Network of elongated particles or rods forming a gel structure. (c) Matted fibers as found in soap gels. (d) Crystalline and amorphous regions in a gel of carboxymethylcellulose

Characteristics of Gels

Swelling

Gels can swell, absorbing liquid with an increase in volume. This can be looked on as the initial phase of dissolution. Solvent penetrates the gel matrix so that gel-gel interactions are replaced by gel-solvent interactions. Limited swelling is usually the result of some degree of cross-linking in the gel matrix that prevents total dissolution. Such gel swells considerably when the solvent mixture possesses a solubility parameter comparable to that of the gellant.

Syneresis

Many gel systems undergo contraction upon standing. The interstitial liquid is expressed, collecting at the surface of the gel. This process, referred to as syneresis, is not limited to organic hydrogels, but has been seen in organogels and inorganic hydrogels as well. Typically, syneresis becomes more pronounced as the concentration of polymer decreases. The mechanism of contraction has been related to the relaxation of elastic stresses developed during the setting of the gel. As these stresses are relieved, the interstitial space available for solvent is reduced, forcing the expression of fluid. Osmotic effects have been implicated, as both pH and electrolyte concentration influence syneresis from gels composed of the ionic gel formers gelatin or psyllium seed gum.

Ageing

Colloidal systems usually exhibit slow spontaneous aggregation. This process is referred to as ageing. In gels, ageing results in the gradual formation of a dense network of the gelling agent. The imer suggests that this process is similar to the original gelling process and continues after the initial gelation, since the fluid medium is lost from the newly formed gel.

Structure

The rigidity of a gel arises from the presence of a network formed by the interlinking of particles of the gelling agents. The nature of the particle and the type of force that is responsible for the linkages determine the structure of the network and the properties of the gel.

Rheology

Solutions of the gelling agents and dispersion of flocculated solid are pseudo plastic i.e., exhibiting Non-Newtonian flow behavior, characterized by a decrease in viscosity with an increase in shear rate. The tenuous structure of inorganic particles dispersed in water is disrupted by applied shear stress due to breaking down of interparticulate association,

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exhibiting a greater tendency to flow. Similarly, for macromolecules the applied shear stress aligns the molecules in the direction of stress, straightening them out and lessening the resistance to flow.

Uses of Gels

Inorganic (Two phase system) Organic (Single phase system)

1. As delivery systems for orally administered drugs.
2. For topical drugs applied directly to the skin, mucous membrane or the eye.
3. As long acting forms of drug injected intramuscularly or implanted into the body.
4. As binders in tablet granulation, protective colloids in suspensions, thickeners in oral liquid and suppository bases.
5. In cosmetics like shampoos, fragrance products, dentifrices and skin and hair care preparations.
6. Lubricant for catheters
7. Bases for patch testing
8. NaCl gel for electrocardiography
9. Sodium fluoride & Phosphoric acid gel for dental care prophylactic

Classification of Gels

Gels can be classified based on colloidal phases, nature of solvent used, physical nature and rheological properties, etc

Based on colloidal phases

a. Inorganic (Two phase system)
b. Organic (Single phase system)

Inorganic (Two phase system)

If the partition size of dispersed phase is relatively large and form the three-dimensional structure throughout gel, such a system consists of floccules of small particles rather than larger molecules and gel structure, in this, system is not always stable. They must be thixotropic-forming semisolid on standing and become liquid on agitation

Organic (Single phase system)

These consist of large organic molecules existing on the twisted strands dissolved in a continuous phase. This larger organic molecule either natural or synthetic polymers are referred as gel formers, they tend to entangle with each other their random motion or bound together by Vander walls forces.

Based on nature of solvent

Hydrogels [Water based]

A hydrogel is a network of polymer chains that are hydrophilic, infrequently found as a colloidal gel in which water is dispersion medium. They are highly absorbent natural or synthetic polymeric networks. They also have a degree of flexibility likely to the natural tissue, due to their significant water content

Uses for hydrogels

1. Sustained-release drug delivery systems
2. Rectal drug delivery and diagnosis
3. Hydrogel-coated wells have been used for cell culture
4. As scaffolds in tissue engineering
5. As environment sensitivity detector
6. Contact lenses (silicone hydrogels, polyacrylamides, polymacon)
7. ECG medical electrode 8. Dressing of healing E.g., Bentonite magma, gelatin, cellulose derivatives, carpooler and poloxamer gel

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Organogels With a non-aqueous solvent

An organogel is a non-crystalline, non-glassy thermoreversible solid material composed of a liquid organic phase trapped in a 3D cross-linked network. The liquid can be, E.g., vegetable oil, an organic solvent or mineral oil. The solubility and particle sizes of the structurant are significant characteristics for the elastic properties and firmness of the organogel. Frequently, these systems are based on self-assembly of the trsucturant molecules.

Xerogels

It is a solid formed from a gel by drying with unrestricted shrinkage. It is frequently retains high porosity (15-50%) and huge surface area (150-900 m2 /g), along with very small pore size (1-10 nm). When solvent removed under supercritical conditions, the network doesn't shrink and a highly porous, low-density material known as an aerogel is produced. Heat treatment of a xerogel at higher temperature produces viscous sintering and efficiently transforms the porous gel into a thick glass.

E.g., Tragacanth ribbons, β-cyclodextrin, dry cellulose and polystyrene, gelatin sheets and acacia tears.[6]

INTRODUCTION OF EMULGEL

Topical medication delivery involves putting a drug-containing formulation to the skin to treat a cutaneous ailment. Applying a formulation containing medicine to the skin to treat a cutaneous condition is known as topical medication delivery. This tactic is employed when dealing with localised skin conditions like fungal infections or when traditional pharmaceutical distribution techniques like oral, sublingual, rectal, and parental are insufficient . Both local and systemic disorders may be successfully treated with topical drug administration. In this delivery technique, the medication enters the body via the skin and travels to the targeted site of action, where it exerts its therapeutic effect. The rate of drug release from a topical preparation is directly impacted by the physiological characteristics of the carrier. One important benefit of topical administration devices is their ability to avoid first-pass metabolism . Among the four drug classes categorised by the BCS, Class II medications have poor solubility and high permeability. It is obvious that class II medications' low dissolution tendency poses more of a challenge to their overall pace and degree of absorption than does their membrane-passing capability. As a result, emulgels may be a better option for topical drug delivery of poorly water-soluble medications. For drugs that are hydrophobic or poorly soluble, emulsified gel has shown to be a more reliable and efficient delivery method.

Anatomy Of Skin

With an area of around 1.7 square metres, the skin is the biggest organ in the body, accounting for 16% of an average person's total weight5 . Its primary role is to serve as the body's barrier of defence, guarding against a variety of external hazards such as allergens, chemicals, UV radiation, pathogens, and moisture loss. The epidermis, dermis, and hypodermis are the three main layers of skin that operate as a barrier of defence and regulate how the body interacts with its surroundings.

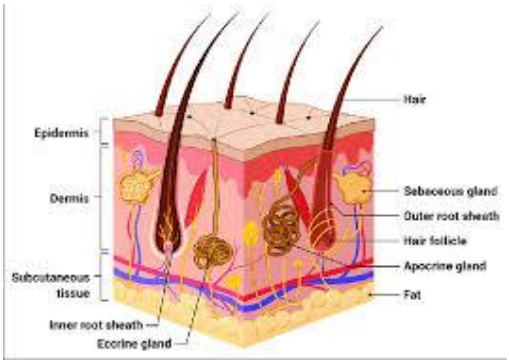

Figure 6 :Represents the skin anatomy

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Hypodermic Epidermis

The thickness of the layers that make up the epidermis varies. The eyelids measure around 0.06 mm while the palms and soles measure 0.8 mm. Curiously, this layer is devoid of blood vessels, thus the epidermal cells must transfer nutrients and remove waste materials across the epidermal-dermal interface in order to reach the dermal cutaneous circulation.

Dermis

The dermis, which has a thickness of 2-3 mm, is predominantly made up of elastin and collagenous fibres, which make up around 70% of the tissue and give the skin its flexibility and strength. Blood vessels are essential to this layer because they provide nutrition to the dermis and the epidermis. To further improve its performance and responsiveness, the dermis also contains neurons, macrophages, and lymphatic veins .

Hypodermis

The word hypodermis, often known as subcutaneous tissue, refers to the layer located under the dermis. The makeup of it consists of elastin and loose connective tissue. The subcutaneous layer contains the vascular plexus, which comprises the arteries and veins responsible for draining the dermis. Dermal arteries infiltrate the papillary dermis layer, producing a complex framework of capillary loops inside the skin. Multiple lymphatic veins pass the hypodermis to reach the specific lymph nodes responsible for emptying the dermis. Interestingly, a significant amount of adipose (fat) tissue is mostly stored in the hypodermis.

Types of Emulgel

Macroemulsion

gel Emulgel that contains particles larger than 400 nm in size is referred to as macroemulsion gel. The tiny drops are fully visible under a microscope, but they are literally undetectable. Although surface-active substances have the potential to stabilize macroemulsions, they are thermodynamically unstable .

Microemulgel

Micro-emulsions do not merge and have droplet sizes ranging from 100 to 400 nm, making them transparent and thermodynamically stable. In certain ratios, water, surfactant, oil, and co-surfactant form microemulsions .

Nanoemulgel

Gel containing nano-emulsion is known as nano-emulgel. Transparent, thermodynamically stable nanoemulsions containing water and oil are stabilised by an interfacial layer of surfactant and cosurfactant molecules with globule diameters smaller than 100 nm.46

Objectives of Emulgel

- Controlled release of drug
- Production feasibility
- Low preparation cost
- Better stability
- better loading capacity

The Following Products Are Available For Topical Delivery:

• External topicals are administered, sprayed, or smeared over the cutaneous tissues in a different manner to cover the desired area.

• For a localised impact, internal topicals are applied to the mucous membrane or rectal tissue[8]

Characterization of Gellified Emulsion

1. Physical appearance: The prepared Emulsion formulations were inspected visually for their color, homogeneity, consistency and pH. The pH values of 1% aqueous solutions of the prepared Gellified Emulsion were measured by a pH meter (Digital pH meter DPH 115 pm)

2. Spreadability: Spreadability is determined by apparatus suggested by Mutimer et al. (1956) which is suitably modified in the laboratory and used for the study. It consists of a wooden block, which is provided by a pulley at one

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end. By this method, spreadability is measured on the basis of 'Slip' and 'Drag' characteristics of emulgels. A ground glass slide is fixed on this block. An excess of emulgel (about 2 gm) under study is placed on this ground slide . The emulgel is then sandwiched between this slide and another glass slide having the dimension of fixed ground slide and provided with the hook. A 1 Kg weight is placed on the top of the two slides for 5 minutes to expel air and to provide a uniform film of the emulgel between the slides. Excess of the emulgel is scrapped off from the edges. The top plate is then subjected to pull of 80gms. With the help of string attached to the hook and the time (in seconds) required by the top slide to cover a distance of 7.5 cm be noted. A shorter interval indicate better spreadability. Spreadability was calculated by using the formula.

$$S= M.L/T$$

Where

S = spreadability,

M = Weight tied to upper slide,

L = Length of glass slides

T = Time taken to separate the slides completely from each other

3. Extrudability study: It is a usual empirical test to measure the force required to extrude the material from tube. The method applied for determination of applied shear in the region of the rheogram corresponding to a shear rate exceeding the yield value and exhibiting consequent plug.flow. In the present study, the method adopted for evaluating emulgel formulation for extrudability is based upon the quantity in percentage of emulgel and emulgel extruded from lacquered aluminum collapsible tube on application of weight in grams required to extrude at least 0.5 cm ribbon of emulgel in 10 seconds . More quantity extruded better is extrudability. The measurement of extrudability of each formulation is in triplicate and the average values are presented. The extrudability is than calculated by using the following formula: Extrudability = Applied weight to extrude emulgel from tube (in gm) / Area (in cm2) Globule size and its distribution in emulgel: Globule size and distribution was determined by Malvern zetasizer. A 1.0 ion for 18 to 24 hours at 25°C, the fungal growth was observed and the percentage inhibition was measured as follows.

gm sample was dissolved in purified water and agitated to get homogeneous dispersion. Sample was injected to photocell of zetasizer. Mean globule diameter and distribution was obtained [43] . Rheological Study: The viscosity of the different emulgel formulations is determined at 25°C using a cone and plate viscometer with spindle 52 (Brookfield Engineering Laboratories,) and connected to a thermostatically controlled circulating water bath.

4. Swelling Index: To determine the swelling index of prepared topical emulgel, 1 gm of gel is taken on porous aluminum foil and then placed separately in a 50 ml beaker containing 10 ml 0.1 N NaOH [44]. Then samples were removed from beakers at different time intervals and put it on dry place for some time after it reweighed. Swelling index is calculated as follows: Swelling Index (SW) % = [(Wt – Wo) / Wo] × 100. Where, (SW) % = Equilibrium percent swelling, Wo = Original weight of emulgel at zero time after time t, Wt = Weight of swollen emulgel Ex–vivo Bioadhesive strength measurement of topical emulgel: (MICE SHAVEN SKIN): The modified method is used for the measurement of bio adhesive strength. The fresh skin is cut into pieces and washed with 0.1 N NaOH. Two pieces of skin were tied to the two glass slide separately from that one glass slide is fixed on the wooden piece and other piece is tied with the balance on right hand side. The right and left pans were balanced by adding extra weight on the left-hand pan. 1 gm of topical emulgel is placed between these two slides containing hairless skin pieces, and extra weight from the left pan is removed to sandwich the two pieces of skin and some pressure is applied to remove the presence of air. The balance is kept in this position for 5 minutes [45]. Weight is added slowly at 200 mg/ min to the left-hand pan until the patch detached from the skin surface. The weight (gram force) required to detach the emulgel from the skin surface gave the measure of bio adhesive strength. The bio adhesive strength is calculated by using following: Bioadhesive Strength = Weight required (in gms) / Area

5. Drug Content Determination: Drug concentration in Gellified Emulsion was measured by spectrophotometer. Drug content in Gellified Emulsion was measured by dissolving known quantity of Gellified Emulsion in solvent (methanol) by Sonication. Absorbance was measured after suitable dilution in UV/VIS spectrophotometer (UV-1700 CE, Shimadzu Corporation, Japan)

6. In Vitro Release Study: Franz diffusion cell (with effective diffusion area 3.14 cm2 and 15.5 ml cell volume) was used for the drug release studies. Gellified Emulsion (200 mg) was applied of onto the surface of egg membrane evenly.

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The egg membrane was clamped between the donor and the receptor chamber of diffusion cell. The receptor chamber was filled with freshly prepared PBS (pH 5.5) solution to solubilize the drug. The receptor chamber was stirred by magnetic stirrer. The samples (1.0 ml aliquots) were collected at suitable time interval. Samples were analyzed for drug content by UV visible spectrophotometer after appropriate dilutions. Cumulative corrections were made to obtain the total amount of drug release at each time interval. The cumulative amount of drug released across the egg membrane was determined as a function time.

7. Microbiological assay: Ditch plate technique was used. It is a technique used for evaluation of bacteriostatic or fungistatic activity of a compound. It is mainly applied for semisolid formulations. Previously prepared Sabouraud's agar dried plates were used. Three grams of the Gellified Emulsion are placed in a ditch cut in the plate. Freshly prepared culture loops are streaked across the agar at a right angle from the ditch to the edge of the plate. After incubat% inhibition = L2 / L1 × 100

Where

L1 = total length of the streaked culture,

L2 =length of inhibition.

analyzed for drug content every two weeks by UV-Visible spectrophotometer. Stability study was carried out by measuring the change in pH of gel at regular interval of time.[8]

Packaging of Emulgels

Emulgel is often packaged in membranesealed lacquered aluminium tubes with an inner coating of a phenoxy-epoxy based lacquer and a propylene screw cap, or aluminium laminated tubes with a moulded seal and a propylene screw cap (Public Assessment Report of Voltaren Emulgel). These lamination tubes combine the advantages of aluminium tubes with the look of plastic. The latest generation of laminate tubes use trimming technology to create tubes with maximal graphic area. The laminate layer stops light, air, and moisture from passing through.

It is made up of two layers: an aluminium layer for integrity and shelf-appealing plastic tubes. The protective barrier serves several purposes, including providing a high gloss protective lacquer, a resistant barrier for items that require optimal compatibility, and flavour and aroma protection with limited absorption.

Material for laminates tubes: Foil laminates: These materials act as a barrier against moisture, air, and light. It decreases the aroma's absorption (flavor and fragrance). Moreover, it exhibits aluminium characteristics with a plastic-like appearance.

All laminated plastic: It features a barrier that resists chemicals. It provides a plastic-like look and feel and aids in maintaining shape and form. It seems to be both opaque and translucent.

STABILITY OF EMULSION

There are two principle requirements to ensure the stability of emulsion.

1. No change in mean particle size or size distribution of droplet of dispersed phase throughout self life.
2. There should be homogenous distribution of emulsified droplet throughout the system

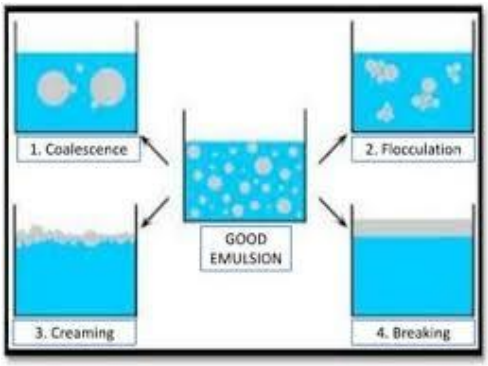

Fig no.7

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FLOCCULATION:

locculation is joining of globules into loose aggregates often redispersed by shaking it is usual for flocculation to produce coalescence.

cause	Remedy
Decreased in repulsive force result in aggregation in globule due to inadequate quantity of emulsifying agent	A high energy barrier exists in the presence of high charge of density on dispersed phase

CREAMING:

Creaming occurs in o/w emulsion dispersed oil globules move upward and accumulate at the top.In w/o emulsion – sedimentation occurs accumulation of water droplets at the bottom. A creamed emulsion usually redispersed by agitation undesirable. Rate of creaming can be reducing by:

- Reducing particle size of globules.
- Equalizing the density of oil and water phases.
- Increasing the viscosity of system

cause	Remedy
Difference between dispersed phase and dispersion medium increased then creaming also increased	Difference between dispersion phase and dispersion medium decreased
Rate of creaming directly proportional to 1 and inversely proportional to viscosity of medium	Storing cool place
Rate of creaming and radius of globule	Use viscosity enhancer
Storage condition : store in cool place	Reduce globule size

CRACKING:

Rupture of interfacial film can lead to coalescence of globule in dispersed phase coalescence may lead complete and irreversible separation of two phases such phase separation is called cracking.Film breakdown arise from:

- Chemical incompatibility of emulsifying agents and content
- May also include by exposures to increased and reduced temperature or by microbial contamination

CAUSE	Remedy
By addition of opposite type of emulsifying agent	Maintain temperature avoid microbial growth.
By decomposition perception of emulsifying agent	Addition of suitable emulsifying agent.

PHASE INVERSION

Phase inversion is the process by which dispersed phase becomes continuous phase and becomes dispersed phase O/w emulsion to w/o emulsion Phase inversion may occur:

- If the amount of dispersed phase increased
- Temperature change
- Addition of material that change solubility of emulsifying agent

Recent Advancement in Emulgel: A Novel Approach for Topical Drug Delivery

Introduction

Topical drug delivery can be defined as the application of a drug containing formulation to the skin to directly treat cutaneous disorder. The topical drug delivery includes the use of topical agents like ointments, creams and lotions, but they are usually very sticky causing uneasiness to the patient on application. Moreover they also have less spreading coefficient and need to be applied with rubbing. They also exhibit the problem of stability. In order to overcome these problems, the use of transparent gels has increased both in cosmetics and in pharmaceutical preparations.

A gel is colloid that is typically 99% by weight liquid, which is immobilized by surface tension between it and a macromolecular network of gelatin fibers. Gels are created by entrapment of large amounts of aqueous or hydro alcoholic liquid in a network of colloidal solid particles. Gel formulations generally provide faster drug release as

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compared to ointments and creams. In spite of many advantages of gels a major limitation is their inability to deliver hydrophobic drugs. To overcome this limitation an emulsion based approach is being used so that a hydrophobic therapeutic moiety can be successfully incorporated and delivered through gels. When gels and emulsions are used in combined form the dosage forms are referred as emulgels. Emulsions possess acertain degree of elegance and are easily washed off from skin. They also have a high ability to penetrate the skin. Emulgels for dermatological use have several favorable properties such as being thixotropic, greaseless, easily spreadable, easily removable, emollient, non-staining, water-soluble, longer shelf life, bio-friendly, transparent &pleasing appearance

Merits of using emulgel Following are the benefits of using emulgel over conventional topical dosage forms

1 Better stability Emulgel show better stability than other transdermal preparations, e.g.: powders are hygroscopic, creams show phase inversion on breaking and ointment shows rancidity due to oily phase.

2 More loading capacity Emulgels have better loading capacity due to their vast network, while other novel approaches like niosomes and liposomes are of nanosize and have vesicular structures. So niosomes and liposomes cause leakage and have lesser entrapment efficiency.

3 Ease of incorporating hydrophobic drugs Most of the hydrophobic drugs cannot be incorporated directly into gel because solubility acts as a barrier and problem arises during release of drug. Emulgel helps in incorporation of hydrophobic drugs into oil phase and then oily globules are dispersed in aqueous phase resulting in o/w emulsion. This o/w emulsion can be mixed into a gel base.

4 Production feasibility The emulgel preparation method comprises of simple and short steps, which increase the feasibility of production.

5 Low preparation cost No specialized instruments are needed for preparation of emulgel. Moreover materials used are easily available and cheaper. This reduces the overall production cost of emulgels.

6 No intensive sonication Production of vesicular preparations (niosomes and liposomes) needs intensive sonication, which may result in drug degradation and leakage. But emulgels don't require intensive sonication, so drug degradation problems can be overcome.

7 Controlled drug release Emulgels can be used to prolong the effect of drugs with shorter half-life.

8 Patient compliance They are less greasy and easy to apply[9]

Emulgel: A Boon for Dermatological Diseases

For decades human skin has offered a novel site for administration of various drugs for both systematic and local application. Many kind of drugs are employed in medical practice for their action upon the skin and mucous membrane. Most of these substances are used for their local pharmacological effects . However stratum corneum that forms the outermost layer of human skin acts as a barrier to most of the drugs and is permeable only to small lipophillic molecules Topical drug delivery is referred to as a localized drug delivery system anywhere in the body through ophthalmic, rectal, vaginal and skin as topical routes. Skin is one of the most readily accessible organs on human body for topical administration and is main route of topical drug delivery system . Topical drug delivery system has several advantages such as ability to deliver drug more selectively to a specific site, avoidance of gastro-intestinal incompatibility& metabolic degradation associated with oral administration Moreover topical deliveries provide an increased bioavailability by avoiding first pass metabolism by liver and a consistent delivery for extended period. USP defines gels as the semisolid system consisting of dispersion made up of either small inorganic particle or large organic molecule enclosing and interpenetrated by liquid. Gels are also said to be the three dimensional polymeric matrices compromising a small amount of solid dispersed in large amount of liquid still having a solid like appearance. Gels as topical drug delivery system possess a no. of advantages like ease of application, less greasy and easily removed . But despite of all these advantages gels have limitation in delivery of hydrophobic drugs.To overcome this disadvantage a novelty is incorporated in gel formulation by introduction of emulgels. Emulgels are the combination of emulsion and gels. Main aim of emulgel drug delivery is delivery of hydrophobic drugs so that hydrophobic drugs can also enjoy various advantages of gel formulation [.Although not only emulgel but various other methods are also available for the topical delivery of hydrophobic drugs. Nano emulsions ,Microemulsions , Proniosomal gels are few techniques used for topical delivery of hydrophobic drugs. In topical drug delivery system drug diffuses out of the delivery system, reaches to the site of action and gets absorbed by the skin. Emulgels are emulsions, either of the oil-in-water or water-

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in-oil type, which are gelled by mixing with a gelling agent. Gels are polymeric matrices with three dimensional structures and emulsion in itself act as a controlled system where entrapped drug particles diffuse out and slowly pass into the skin . Thus emulgels are a combination of both emulsion and gels and act as a dual control release system for hydrophobic drugs. One of the problems encountered with the topical drug administration is skin penetration due to high concentration of active pharmaceutical moiety

Penetration pathways There are three penetration pathways available for topically applied drugs :

• Intercellular

• Follicular

• Transcellular Intercellular: It is defined as the transport of drugs through junction between the epithelial cells .

Intracellular: It is defined as passage of drugs across the epithelial cells .

The Dermatological Diseases:

Dermatological diseases are very common in tropical world as well as other parts of world. They may be caused due to Various fungus, bacteria's viruses etc. Fungal infections are common in tropical countries and can have an important impact on public health. Lobomycosis is a common fungal infection in the tropical rain forest of South America, and paracoccidioidomycosis (South American blastomycosis) is a widespread and sometimes severe illness. Penicilliosismarneffei is an opportunistic infection of AIDS patients in Southeast Asia. Chromoblastomycosis and mycetomas are causes of morbidity around the world. Sporotrichosis is a worldwide subcutaneohair follicle acts as a pathway for penetration of topically applied drugs ubcutaneous mycosis with a high incidence in tropical countries and is an important illness in immunocompromised patients. Rhinosporidiosis was classed as a fungal infection but is now considered a protistan parasite that belongs to the class Mesomycetozoea

The most common Topical Dermatological Diseases are one of the followings:

1. Acne: Acne is disorder of skin sebaceous gland and result in clogged pores and lessions commonly called pimples or jits. The main cause is high hormone level. common OTC medication for acne are: Benzyl peroxide, salicylic acid etc. Prescription topical medications are: erythromycin, clindamycin.

2.Psoriasis: It is fundamentally an inflammatory skin condition with reactive abnormal epidermal differentiation and hyperproliferation affecting 2-3 % of world‟s population. Pathophysiology of the disease includes mainly the activation and migration of T cells to the dermis triggering the release of cytokines (tumor necrosis factor-alpha TNF-alpha, in particular) which lead to the inflammation and the rapid production of skin cells. The possible factors and triggers causing psoriasis include emotional stress, skin injury, systemic infections, certain medications and intestinal upsets Topical treatments are usually the first to be tried when fighting psoriasis that include (emollients, dithranol, tar, deltanoids, corticoids, tacrolimus etc.

3.Tenia Pedis: Tinea pedis (athlete's foot) is one of the most common superficial fungal infection of the skin in all regions of the world. Mycotic infections of the foot are common in adult males and uncommon in women and children. Topical antifungal agents are generally adequate in tinea pedis infection. Fungicidal drugs (as terbinafine, butenafine and naftifine) are often preferred over fungistatic drugs for the treatment of tinea pedis infection because its course can be as simple as one application daily for one week treating with high cure rate.

4. Atopic Dermatitis: It is a familial, chronic inflammatory skin disease that commonly presents during early infancy and childhood but can persist or start in adulthood. Atopic dermatitis (AD) is often the first manifestation of allergic disease. Most patients with AD will also have another atopic disorder, such as allergic rhinitis, asthma, or food allergy. Therefore the evaluation and management of AD are an integral part of an allergist/immunologist’s training and practice. First line treatment include Skin hydration, and topical corticosteriods. .

5.Onychomycosis: Yellow-brown patches near the lateral border of the nail. Beneath the masses of soft horny debris accumulate & the nail plate gradually becomes thickened, broken & irregularly distorted. Most of the infections are caused by Trichophyton rubrum, T. inerdigitale. [20]

6.Tinea Unguis(Ringworm): Characterized by nail thickening, deformity and eventually results in nail plate loss.

7. Atopic Eczema: Atopic eczema is the commonest inflammatory skin disease of childhood. Itching, skin damage, redness, sores, sleeploss are various characteristics of eczema. Topical corticosteriods, topical calcinurin inhibitors, various emollients are used in its treatment.

Incorporation of Hydrophobic drugs into Emulgelformulation

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Gels show a major limitation during incorporation of hydrophobic drugs as solubility act as a barrier and release of drug from formulation is not good. However, emulgels solve this problem by easy incorporation of hydrophobic drugs into gel base as follows

Incorporation of Hydrophobic drug into oil phase

Oily globules are dispersed into aqueous phase

This result in o/w emulsion

This emulsion is mixed into gel base[10]

Marketed Formulations of Emulgel

Marketed formulation	API	Manufacturer	Use	product
1.Voltaren emulgel	Diclofenac diethyl ammonium	Novartis Pharma	Anti-inflammatory	
2.Miconaz-Hemulgel	Miconazo le nitrate, Hydrocortisone	Medical union Pharmaceutical	Topical corticosteroid & antifungal	
3.Levorag emulgel Hibiscus	licorice, natural extracts THD Ltd Emollient	THD Ltd	Emollient	
4.Isofen emulgel	Ibuprofen	Beit Jala pharmaceutical	Anti-inflammatory	

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Applications of Emulgel with use and Route of application

Sr.No	Drug	Route	Applications
1	Mangostin Extracts	Topical Emulge	Food Supplements, Pharmaceuticals and Cosmetics
2	Metronidazole	Topical Emulge	Rosacea
3	Propolis	Topical Emulgel	Burn and Wound
4	Dexibuprofen-Capsaicin	Topical Emulgel	Acne
5	C. tamala Leaves Extract	Topical Emulgel	Skin Photo-Damaging Effects
6	Tretinoin	Topical Emulgel	Anti-Inflammatory Activity
7	Acyclovir	Topical Emulgel	Cold Sore
8	Desoximetasone	Topical Emulgel	Plaque Psoriasis
9	Atorvastatin	Topical Emulgel	Wound Healing
10	Diclofenac Diethylamine	Topical Emulgel	Analgesic
11	Brucine	Topical Emulgel	Anti-Inflammatory and Anti-Nociceptive Activities
12	Meloxicam	Topical Emulgel	Rheumatism
13	Curcumin	Topical Emulgel	Anti-Inflammatory Activity
14	Melatonin	Topical Emulgel	An Anti-Aging and Skin Protective Agent
15	Betamethasone Sodium	Topical Emulgel	Ocular Drug Delivery
16	Itraconazole And Clotrimazole Emulgels	Topical Emulgel	SporothrixBrasiliensi
17	Furbiprofen	Topical Emulgel	Arthritis

NEG as an Advanced Approach in Topical Drug Deliver

NEG as an Advanced Approach in Topical Drug Delivery NEG is a trimming method used in the topical delivery of hydrophobic drugs. The nanoemulsion and a gelling agent are combined to create the NEG. Most research is now focused on the transdermal administration of hydrophobic medicines using NEG technology. Because of the poor drug permeability through the skin caused by large particle size, the therapeutic uses of many traditional dosage forms, such as creams, ointments, gels, emulsions, and emulgels, are constrained.

The NEG concept was developed as a result in order to solve the permeability issue In NEG, a nanoemulsion is a solvent droplet that is stabilised by surfactants without using penetration enhancers . Many investigations found that nanoemulsions delivered drugs to the skin more effectively than traditional emulsions, gels, creams, and ointments . substantial voids and gaps in the skin samples treated with nanoemulsions as well as the drug extent retention at the site of action show that lipid bilayer rupture may be the cause of the increased permeability of medications from topical formulations of nano dimensions[35,36]. While nanoemulsion has several benefits, its low viscosity, spreadability, and stability restrict its use on the skin.

Future Perspectives

The formulation researcher's key challenge is to create a novel formulation in order to deliver hydrophobic medications because of their poor water solubility, which eventually reduces the bioavailability of drugs. As 40% of the drugs are hydrophobic, it has proven difficult to transfer them to the biological system. As a result, one of the key strategies for overcoming the drawbacks of oral medication delivery, such as drug solubility and bioavailability, is topical drug administration. The topical distribution of these kinds of hydrophobic drugs has been said to be improved by using emulgel, one of the several topical formulation techniques

A dual control release mechanism is produced when an emulsion is added to gel. Moreover, issues with emulsion creaming and phase separation are fixed, and its stability is increased. Due to the largre particle size of emulgel, drug permeability is its main drawback; this issue can be resolved by NEG systems, which include nanoemulsion into the gel matrix.

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The NEGis made by including active ingredients that are efficient against bacterial, fungal, viral, or even melanoma infections. Nevertheless, additional molecular analysis on the medication absorption mechanism should be required. Hence, emulgel or NEG might be a possible drug delivery vehicle to treat certain dermatological conditions and numerous systemic diseases[11]

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