EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 11
Issue: 5
86-90
Year: 2024

EMULGELS: AN EFFECTIVE DRUG DELIVERY SYSTEM

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Article Received on 06/03/2024 **Article Revised on 27/03/2024** **Article Accepted on 17/04/2024**

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 emulgel. Emulgels 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: Topical drug delivery, Emulgel, surfactant, bioavailability.

INTRODUCTION

Topical drug delivery refers to the application of a drug-containing formulation to the skin to treat a cutaneous condition. This system is used when other routes of drug administration (such as oral, sublingual, rectal, and parental) fail, or when a local skin infection, such as a fungal infection, occurs 1. Topical drug administration is a common treatment method for both local and systemic conditions. In the topical delivery system, the drug is absorbed by the skin and reaches the site of action to provide a therapeutic effect. The rate of drug release from a topical preparation is dependent directly on the physiological features of the carrier 2. The primary benefit of a topical delivery system is that it avoids the first-pass metabolism. The term microemulsion is based on particle size. Due to their smaller size, the drug particles can easily diffuse through the skin and reach their site of action. The gel will hold the microemulsion for a long time and will aid in the sustained release of the drug. Various fungal infections are growing nowadays which are a major problem for society. Fungal infections such as Tinea capitis, Tinea pedis and Tinea corporis infect the skin severely. A technique such as emulgels can aid in the easy penetration of the drug into the skin and provide a rapid onset of action.[1]

Skin

Skin is the outermost tissue of the body and the largest organ in terms of both weight and surface area. It has an area of approximately 16, 000 cm2 for an adult and represents about 8% of the body weight. Skin has a very complex structure that consists of many components. Cells, fibers and other components make up several different layers that give skin a multi-layered structure. Veins, capillaries and nerves form vast networks inside this structure. In addition, hairs stick out from the inside of skin.

Layers of skin: Three layers of tissue make up the skin:

1. Epidermis

The epidermis is the outermost layer of skin. There are no veins and capillaries in this layer. Its thickness is about 0.2 mm on average and this thickness varies depending on the location on the body. Furthermore, the thickness also varies according to the volume of water that the epidermis holds.

The epidermis is further divided into five sub layers. From the bottom (innermost), these sub layers are stratum basale (basal cell layer), stratum spinosum (prickle cell layer), stratum granulosum (granular cell layer), stratum lucidum (clear layer) and stratum corneum (horny cell layer).

2. Dermis

The dermis is the second layer of skin, beneath the epidermal layer. This layer is much thicker than the epidermis (usually 1 to 4 mm). The main components of

the dermis are collagen and elastin fibers. Compared to the epidermis, there are much fewer cells and much more fibers in the dermis. Dermis has the following two sub layers.

Papillary layer

It is the upper sub layer of the dermis that is clearly demarcated from the epidermis. This sub layer is a loosely connected tissue and includes a large amount of nerve fibers, capillaries, water and cells (e.g. Fibroblasts). In this sub layer, collagen fibers form a finer network than those of the reticular layer.

Reticular Layer

It constitutes the lower part of the dermis and represent a continuous transition to the sub cutis. This sub layer has a denser and thicker network than the papillary layer and includes fewer nerve fibers and capillaries. In this sub layer, collagen fibers are aggregated into thick bundles which are mostly aligned parallel to the surface of skin.[2]

3. Hypodermis

Hypodermis in histology, is the third layer beneath the dermis. It is important to note that it is not categorized as another skin layer. Sub cutis is an elastic layer and includes a large amount of fat cells that work as a shock absorber for blood vessels and nerve endings. The thickness of this layer is reported to be 4 to 9 mm on average. However, the actual thickness differs from person to person and also depends on the body region.[3]

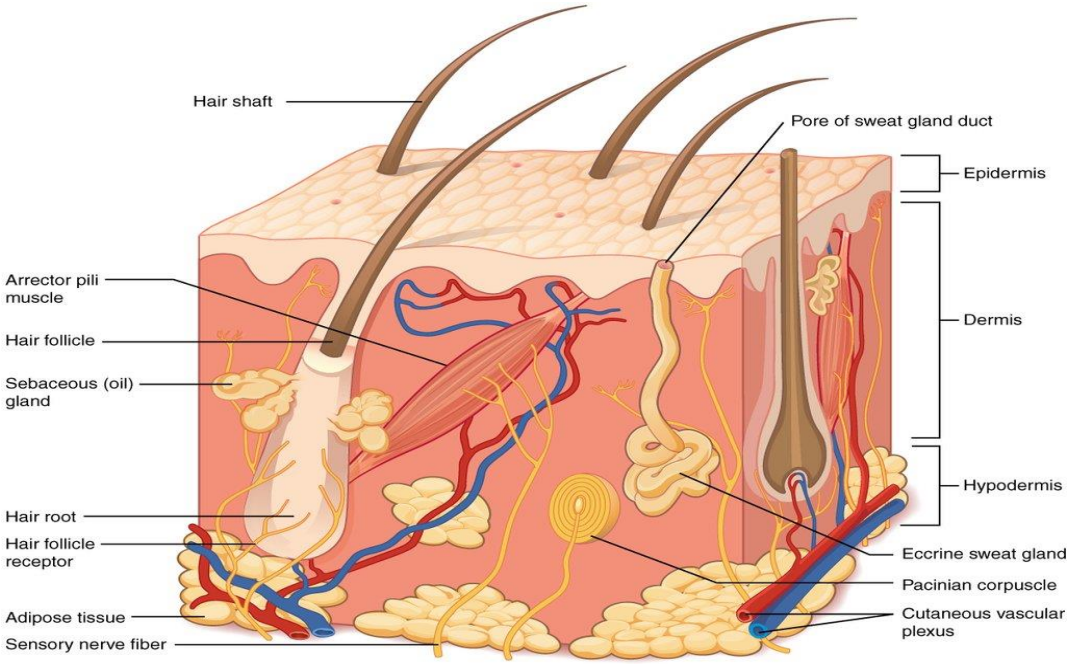

Fig. 1: Cross-section of skin.

Gel

The 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.[4]

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.

Emulgel can deliver both hydrophilic and lipophilic drugs due to the presence of both aqueous and non-aqueous phases. In recent years, they have been used as a control release formulation. These are biphasic systems that have better drug loading capacity and better stability.[10,11] Emulgel has several good properties, such as good spread ability, greaseless, thixotropic, good shelf life, odorless, and a pleasant appearance over the conventional topical formulation. Emulgel has both gel and emulsion properties and functions as a dual control release system.[5]

Types of Emulgel

1 Microemulsion

Microemulsions are isotropic mixtures of a biphasic o/w systemic stabilized with a surfactant that is thermodynamically stable and optically clear. Droplets vary in size from 10 to 100nm and do not coalesce. It is made up of specific amounts of oil, co-surfactant, surfactant, and water. Microemulsions may have unique properties, including extremely low interfacial tension, a broad interfacial region, and the ability to dissolve both aqueous and oil-soluble compounds. The ingredients in microemulsion could help the drug permeate faster by lowering the stratum corneum's diffusion barrier.

However, because of their low viscosity, the use of microemulsions in the pharmaceutical industry is limited due to their low skin retention ability. To address this limitation, gelling agents like HPMC K100M, Carbopol 940, and guar gum are added to the microemulsion to form microemulsion-based gels with a viscosity appropriate for topical application.[6,7,8]

2 Nanoemulgel

Nanoemulsion is transparent (translucent) oil-water dispersions that are thermodynamically stable due to surfactant and cosurfactant molecules with a globule size range from 1nm to100 nm. When the emulsion is mixed with gel, the term Nanoemulgel is used. Many drugs have higher transdermal permeation with Nanoemulsion than with traditional formulations such as emulsions and gels. The Nanoemulsion possesses enhanced transdermal and dermal delivery properties in vivo as well as in vitro. Because of its high loading capacity and small globule size, the drug easily penetrates the skin and provides less therapeutic effect in a short period.

3 Macroemulsion gel

Emulgel with emulsion droplet particle sizes greater than 400nm. They are physically invisible, but under a microscope, the individual droplets can be seen clearly. Macroemulsions are thermodynamically unstable, but surface-active agents can help to stabilize them.

Advantages of Emulgel

- ✓ Using water/oil/water emulsions, hydrophobic drugs can be quickly implemented into the gel base.
- ✓ Improved stability and load capacity.
- ✓ Easy for production and a low-cost mechanism.
- ✓ Avoid sonication.
- ✓ The first metabolism is avoided.
- ✓ Avoid gastrointestinal incompatibility.
- ✓ Target drug delivery on the body.
- ✓ Improved patient compliance.
- ✓ Improved patient acceptability and suitability for self-medication.
- ✓ Ability to easily terminate medication.[9]

Disadvantages of Emulgel

- ✓ The drug and/or excipients can lead to skin irritation in people with contact dermatitis.
- ✓ Some medications have low permeability through the skin.
- ✓ Possibility of allergenic reactions.
- ✓ Larger-particle-size drugs are not easily incorporated into the skin.[10]

Components of Emulgel

Oils are used as an oil phase to prepare an emulsion. Mineral oil and soft or hard paraffin are commonly used, either alone or in combination, in topically applied emulsions.

Example: Castor and mineral oils, which have laxative effects, are the most commonly used oils for oral and topical preparations.[11,12]

1. Vehicles

In the emulgel preparation, oily and aqueous vehicles are used, and both hydrophobic and hydrophilic drugs are used.

Examples of vehicles such as alcohol, water, and other aqueous materials are used in aqueous phase emulsions.[12]

2. Emulsifiers

To improve shelf-life stability, an emulsifier is used to increase the emulsification of the preparation. Examples of emulsifying agents are Tween 80, Span80, Tween 20, stearic acid, etc.[13]

3. Gelling agent

Gelling agents are used for preparing gels for any dosage form. It enhances the consistency of any formulation. Some examples of gelling agents are Carbopol 940, Carbopol 934, HPMC-2910, etc.[14]

4. pH adjusting agent

These agents are used to maintain the pH of the formulation. Example: triethylamine, NaOH, etc.

Characterization of Emulgel

1. Physical appearance

The color, consistency and homogeneity of the prepared formulation are visually inspected for observations of physical properties.[15]

2. pH measurement

A digital pH meter is used to determine the pH of all prepared emulgel. Calibration of the pH meter is performed before using a standard buffer solution. 1 gm of the formulation is dissolved in distilled water until a uniform suspension is formed and is kept aside for 2 hours. After 2 hours the glass electrode is dipped in the suspension and the pH is measured.[16,17]

3. Rheological study

The viscosity of the prepared formulation is determined at 370C using a cone and plate Brookfield viscometer.[18]

4. Stability study

Stability studies are carried out by inducing stress at different temperatures and humidity (room temperature of 300C±20C, RH of 65%±5% and room temperature of 400C±20C, RH of 75%±5%) using a stability chamber with proper excipient quantity (API-0.1gm, oil-2.5gm, surfactant-6.665gm co-surfactant-13.33gm, double-distilled water 27.15ml).

The study is done for 1 month and observation is done for physical changes such as a change in clarity, observance of turbidity and detection of particle growth.[19,20]

5. Skin irritation test

Skin irritation test is usually done in skin of human volunteers with proper written consent. The prepared formulation is applied to the skin of the hand and observation is done to check for any undesirable effects.[21]

6. Zeta potential

The Zeta potential of the emulgel preparation is determined by zetasizer (Malvern Zetasizer) The formulation is placed in a clear, disposable zeta cell, and the result is determined. Before experimenting, cuvettes are washed with methanol and then the sample is placed.[22]

Particle size and polydispersity index (PDI)

The globule size of emulgel is measured at 250C by using a zetasizer (Malvern zetasizer instrument, ZS90). The sample is diluted before the experiment

7. Swelling Index

1 mg of gel is placed on porous aluminium foil separately in a 50 ml beaker that contained 10 ml of 0.1 N NaOH. The sample is removed from the beaker at various time intervals and kept in a dry place for some time after it is reweighed.[23,24]

Swelling index (SW) = [(Wt.-Wo)/Wo] x a hundred.

Where (SW) %= Equilibrium percentage swelling.

Wo= Original weight of emulgel at zero time where time t,

Wt= Weight of swollen emulgel

8. Drug Content determination

A spectrophotometer is used to determine the drug concentration in the emulsion. The drug content of an emulsion is determined by sonicating a known amount of emulsion in a solvent (methanol). In a UV/VIS spectrophotometer, absorbance is measured after appropriate dilution.[25]

CONCLUSION

Emulgel is a novel approach that has been proven to be the most convenient, superior, and efficient delivery system. Because of its non-greasy nature and lack of oily bases, it gives gel-like properties and gives excellent drug release when compared to conventional topical delivery systems. Emulgel has a high drug loading capacity and is effective in drug delivery at the target site. Penetration of a drug through the skin is effective due to its small particle size. Emulgel is formed by incorporating emulsion into the gel base and provides a dual control release effect. The emulgel technique helps to solve different problems, such as creaming, phase separation and its stability improves. Hydrophobic drugs can be delivered with the help of emulgel and they can be incorporated into the oil phase of the emulsion and combined with gel. This technique improves patient compliance and increases the bioavailability of the drug in specific areas.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my parents and my guide Dr. Satkar Prasad for invaluable contribution for my review paper. I am grateful to the reviewers for their constructive comments & suggestions that helped me to improve the quality of this review paper.

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