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FORMULATION AND EVALUATION OF EMULGEL

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Abstract : Drug delivery systems (DDS) are made with the goal of effectively delivering drugs throughout the body while taking into account the demands of the patient and the intended therapeutic outcomes. Topical medication delivery is a popular technique that uses formulations like emulgels to provide drugs locally via the skin. Emulgels are especially helpful for administering hydrophobic medications, providing benefits in terms of stability, drug loading capacity, and skin penetration. Emulgels combine the properties of emulsions and gels.

The effectiveness of topical medication absorption is influenced by physicochemical parameters like molecular mass and physiological factors like skin thickness and blood circulation. Important ingredients including carriers, emulsifiers, gelling agents, and penetration enhancers are used in the creation of emulgels. To enhance emulgel formulations for efficient drug delivery, evaluation techniques such as pH testing, globule size analysis, and accelerated stability tests are crucial

IndexTerms **– Drug delivery systems , topical drug delivery systems , Emulgel , Emulgel formulation , Evaluation of Emulgel.**

I. INTRODUCTION

Drug Delivery system various delivery system is designed and Formulated in such a way that we get desired action and required therapeutic effect in our body. The includes various methods in which needs of the patient, how easy the delivery is and what effect the drug gives are taken into action. Some industries or pharma labs invent their own technique of drug delivery or some depend on the original technique are give credit to the inventor itself. The company which use already patented technique are required to give the original inventor credit or legal action or ab hearty fee is liable.

DDS is the system which help move around drugs in the body and give desirable action. Many drug Delivery system came into action after late 1950s.

What are drug Delivery system?

This is a Delivery method like a tablet which is swallowed or suppositories introduced in our body. This can also be described as drug which are stuffed like a nanoparticle. The protective cover in the suppositories or tablet helps it protect the drug not mortify and move around to its desired location. This field of Drug delivery system has improved and showed advancement in the past century. Drug Delivery system help us understand Physiological barriers and help in Development of Drug delivery system.

Biomedical engineers have made significant contribution to our knowledge of the physiological obstacles to effective drug administration as well as to the creation of a number or novel drug delivery technique that are now being used in clinical settings.

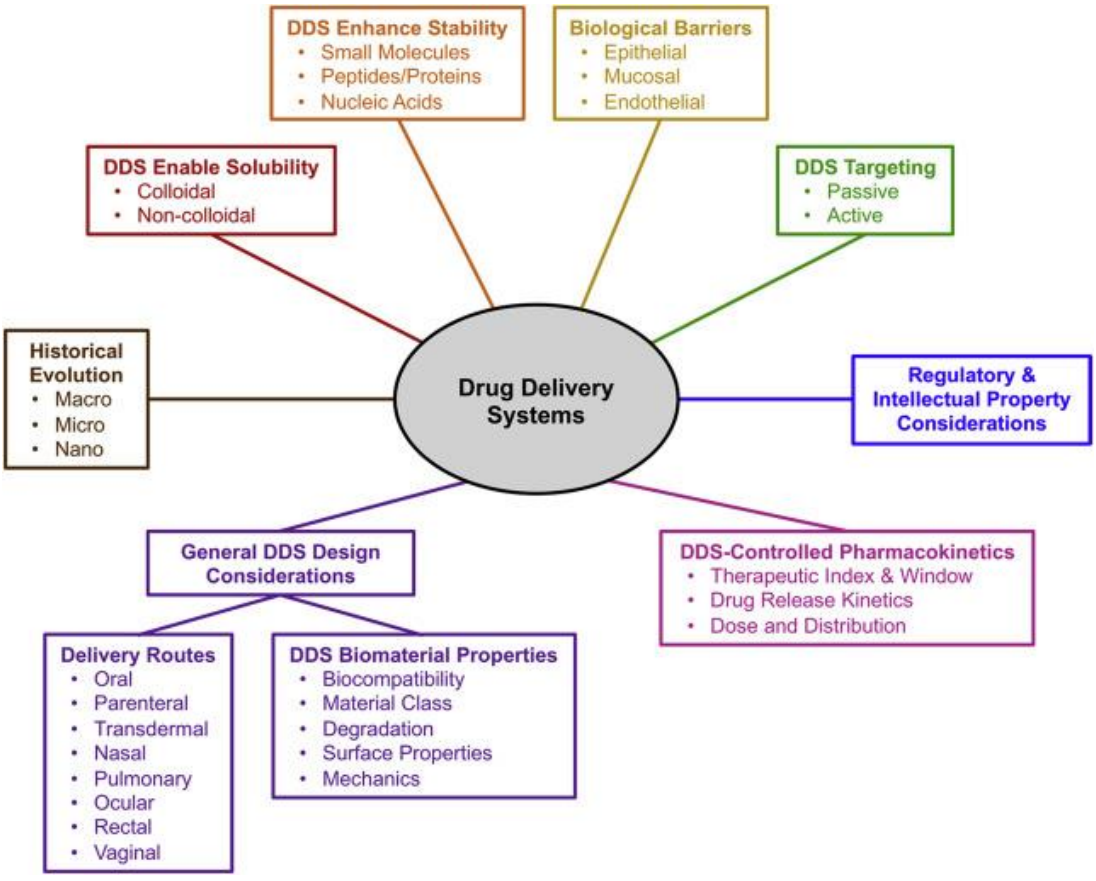
Even IF drug delivery systems are more reliable method it skill may have ungodly side effect it is because at the end of the Day it is chemical which interact with our healthy body system.

Types of Drug Delivery system:

- Transdermal
- Nasal
- Intranasal
- Liposomes
- Controlled release
- Nanoparticle

- Nano-biotechnological
- Drug carries
- Sublingual
- Mucosal
- Implantable
- Gastrorententive
- Nano-pulmonary
- Targetted
- Ocular
- Intra-uterine
- Oral
- Topical

TOPICAL DRUG DELIVERY SYSTEM:



Topical drug administration refers to localised delivery of medication through, cutaneous, ocular rectal and vaginal channels to any part or the body. One of the human body's easiest organ to administer topically is the

skin, which serves as the primary routes for topical medication delivery system. This review covers every detail for pertaining to rational topical formulation method, topical permeation principles and Fundamental topical drug delivery system components.

Accordingly topical gel most reliable, effectual treatment for used in skin-related disorders. Topical preparation is surface oriented and have systemic effect. Ointments and gels mostly have API which is emulsified in the based product. They provide therapeutical value. Terms used to categorize the bases of topical preparation in which therapeutically active ingredients are in cooperated include suspension, liniments hydrophilic creams, and physical properties such as intended use and composition. The combination of active ingredient and base allows for a wide range of topical preparations appropriate for many types of drug delivery and therapy.

Dermatological problems, or skin condition have been increasing in last decade. Advancement in this Field will help us maximize and sustainability.

These delivery methods are a significant improvement over conventional system (creams. lotion, ointment, and paste) when used alone or in combination. They may also improve patients' compliance (including the quality of life for dermatologists) and address other unmet needs in the topical dermatology market.

Topical Drug Delivery system may replace needles for biological sustainability and help in paediatric study.

However, owing of the skin's unwavering barrier qualities the limited epidermal and transdermal transport of a number of small and big molecules presents a significant problem.

EMULGEL

A greatest disadvantage of gel is hydrophobic drug and problems we face during its delivery.

In order to get around these constraints an emulsion-based strategy is being employed allowing even a hydrophobic medical moiety to benefit from the special qualities of gel. A new approach is studied in which skin is a match organ for treatment.

Both hydrophilic and hydrophobic chemicals are blocked by the mixture of hydrophilic cornified cells in hydrophobic intracellular material. The use of transparent cell is widely used in cosmetic and pharmacology. preparations or Formulation. When a gelling agent is present in the water phase it converts and emulsion into an emulgel. These emulgel offer significant advantages over both tradition and new vesicular system in a number of areas, Since different permeability enhancers can increase the effects, emulgel are a superior topical drug delivery modern technology than current ones. Emulgel may additionally be used in antifungal and painkilling drug.

Medications are put on topically in order to have systemic effects or to act localized. If the drug is in solution, has a desirable lipid/water partition coefficient, and is a nonelectrolyte, its penetration via the skin is enhanced. The vast majority of the time, the pharmaceutical preparations applied cosmetically have the goal to have a concentrated effect; hence, they aim to provide extended localised contact with little systemic drug absorption. Skin emollients, protectants, antifungal agents, and antiseptics are among the drugs can are applied topically for their concentrated effects.

The primary benefit of topical delivery systems is their ability to circumvent first-pass metabolism.

The topical drug delivery technique is typically employed in cases where other drug administration methods are ineffective, or it is mostly used to treat fungal infections and anti-inflammation action.

The human skin is an uniquely constructed organ that supports life on Earth by managing body moisture and temperature loss while preventing the entry of infectious agents or microorganisms.

It encompasses an average of 1.7 m2 and accounts for up 10% of the average person's body mass, which makes it the largest organ in the human body.

The human skin is an exceptionally successful self-repairing barrier that seals the external environment out and the inside in, despite the fact that such a massive and accessible organ promises to offer excellent and numerous opportunities to administer therapeutic substances for both local and systemic activities.

Large volumes of aqueous or hydroalcoholic liquid are trapped in a network of colloidal solid particles to make gels, a relatively novel type of dosage forms. These particles can be inorganic, like aluminium salts, or organic, such synthetic or natural polymers.

Gels have many benefits, but one significant drawback is their inability to distribute hydrophobic medications. In order to get around this restriction, emulgels are made and applied in a way that allows even a medicinal moiety that is hydrophobic to benefit from the special qualities of gels.Different medications are delivered to the skin using water-in-oil and oil-in-water emulsions.

Thixotropic, greaseless, readily capable of spreading, readily removed, emollient, nonstaining, long shelf life, bio-friendly, apparent and aesthetically pleasing are just a few of the beneficial features of emulgels for use in dermatology.
In the past few decades, conventional methods of managing illness—such as oral, sublingual, rectal, parental, etc.—have been employed.
Other benefits of topical preparations include avoiding the hazards and hassles of intravenous therapy as well as the various circumstances of absorption such as pH fluctuations, the presence of enzymes, and gastric emptying time.
These are treating their healthy or sick skin using a variety of dermatological and cosmetic preparations.
Despite the dosage forms of dermatological medicines vary and their consistency can range from liquid to powder, semi-solid versions are the most widely used. Transparent gels have become more widely used in pharmaceutical and cosmetic preparations, forming two primary types of semisolid preparations.

Physiological Factors Affecting Drug Absorption Topically:

Physiological factors:

1. Skin thickness
2. The lipid profile.
3. The hair follicles' density.
4. Sweat gland density.
5. pH of the skin.
6. Blood circulation.
7. Skin hydration.
8. Skin inflammation

Physiochemical Elements:

1. The coefficient of partition.
2. Molecular mass (less than 400 daltons).
3. Ionization degree (only medicines that are unionized absorb properly).
4. The impact of vehicles

Factors to be Considered When choosing a Topical Preparation:

1. The vehicle's effect For example, an occlusive vehicle increases the active ingredient's penetration and boosts efficacy. The car itself could function as a cooling, drying, emollient, or shielding agent.
2. Align the preparation kind with the lesion type. For example, if you have extreme weepy dermatitis, stay away from fatty ointments.
3. Align the site-appropriate level of preparation. (For hairy regions, use lotion or gel.)
4. Potential for irritation or hypersensitivity. In general, gels are irritating, whereas ointments and w/o creams are less so.If an allergy to preservatives or emulsifiers is a worry, ointments don't contain these ingredients.

Considerations for Selecting a Topical Preparation:

1. Chemical enhancement
2. Physical enhancement
3. Biochemical enhancement
4. Supersaturation enhancement

Blood can be delivered directly to the plexus from the tiny blood vessels in the body's most exposed areas—the hands, feet, and ears—through highly muscular arteriovenous anastomoses.
One distinctive feature of dermatological pharmacy is the ability to directly access the skin as a target organ for both diagnostic and treatment.
For the purpose of to stop the absorption or loss of sodium and potassium, the skin functions as a two-way barrier. Topical medication absorption occurs across a trio of primary mechanisms: follicular, intercellular, and transcellular.

The vast majority of pharmaceuticals go through the dangerous route that surrounding corneocytes and the lipid bilayer to reach the skin's viable layers.

The pilosebaceous route is the next most popular (and probably underrated in the clinical setting) oversight method. About identical rates of chemical penetration via isolated stratum corneum or entire skin indicate that the barrier resides in the outermost layer of the epidermis, the stratum corneum.

For years, pharmaceuticals that fight infections and relieve pain have been applied to the affected area of the body using creams and gels that are massaged into the skin.

These include, among other things, topical creams for skin infections, gels and creams for vaginal yeast infections, and creams to relieve pain caused by arthritis. Other medications can now be absorbed through the skin thanks to new technologies (transdermal). These can be used to treat the entire body besides to the afflicted parts (such the skin)(systemic)

ADVANTAGES:

1. Enhanced acceptance of patients.
2. Provide focused medication administration.
3. The therapy can end at any point.
4. Increase absorption; low doses can still be effective when compared to other traditional semi-solid preparation methods.
5. Reduced surface interfacial tension increased the aqueous phase's viscosity, making the formulation more stable than transdermal formulations, which are often less stable. 5.
6. By utilizing emulsion as the drug barrier before it is finally dispersed into gel, hydrophobic drugs can be blended into emulgel form with ease.
7. Offer the regulated impact that contributes to extending the duration of a medication with a brief half-life.
8. A simple and economical way to prepare.
9. Compared to other innovative dosage forms like niosomes and liposomes, the drug loading capacity is higher.
10. The combination of hydrophilic and hydrophobic properties improves skin penetration.

DISADVANTAGES:

1. Cause issues with macromolecule absorption.
2. An air bubble that is trapped during formulation.
3. The ideal medications for these delivery methods are those that are hydrophobic.
4. Contact dermatitis-related skin irritation
5. The potential for allergic responses
6. Certain medications have limited skin permeability

FORMULATION OF EMULGEL:

1. VEHICLE

The vehicle has following properties.

i. Apply the medication to the skin evenly and efficiently.
ii. Allow the medication to easily travel to the site of action by releasing it.
iii. Send the medication to the intended location.
iv. Maintain a therapeutic medication concentration in the intended tissue long enough to provide a pharmacological effect.
v. Suitably prepared for the anatomical location that has to be addressed.
vi. Aesthetically pleasing enough for the patent.

The epidermal barrier's effectiveness means that hardly much topical medication typically passes through the stratum coreum. Rate as well as the degree of absorption varies based on the vehicle's properties as well as the active agent itself.

(A) AQUEOUS MATERIAL

This creates the emulsion's aqueous phase. Commonly utilized agents include alcohols, water, and so on.

(B) OILS

These substances make up the emulsion's oily phase. Mineral oils for external use, either by itself or in combination with gentle or hard paraffin, are frequently utilized for their occlusive and sensory properties as well as serving as the drug's transport. Non-biodegradable mineral oils, castor oils that have a local laxative action, and fish liver oils or other fixed oils derived from vegetables (such as arachis, cottonseed, and maize oils) are often used oils in oral preparations.

2. EMULSIFIERS

Emulsifying compounds are used to manage stability over a shelf life that can range from days for spontaneously generated emulsions to months or years for commercial preparations, for example, and to encourage emulsification during the manufacturing process. Sorbitan mono oleate, 40 percent polyethylene glycol Sodium stearate, polyoxyethylene sorbitan monooleate (Tween 80), and stearic acid.

3. GELLING AGENT

These substances are thickening agents as well as ones that are used to improve the consistency of any dosage form.

4.PENETRATION ENHANCERS

Drug delivery vehicles frequently contain penetration-enhancing chemicals to facilitate drug absorption. These substances may temporarily break the skin barrier, fluidize the lipid channels between corneocytes, change how the drug is partitioned into skin structures, or improve delivery into the skin in other ways. referred to as "penetration enhancers"

Optimization and Evaluation

1. pH measurement: Using a pH meter, the pH range of many topical treatments is between 5 and 6. Take 1g of the product and dissolve it in 10ml of water to determine the pH. To reduce error, the PH of every formulation is performed in triplicate.
2. Globules size measurement: A sample of 1.0 gm of the product was put into the Malvern zetasizer's photocell after it had been dissolved in water and swirled to produce a dispersion.
3. Swelling Index: 10 milliliters of 0.1 N NaOH solution are added to 1 gram of produced emulgel that has been spread out on porous aluminum foil. Sample taken out at different intervals, and weight is recorded until it stops changing:

Swelling Index (SW) % = [[Wt-Wo]/Wo]*100
Where, and (SW) % = Percentage swelling
Wo = Emulgel's initial weight,
Wt = Weight of emulgel at time t that has swelled.

4. Determining the bioadhesive strength involves precisely applying 1 gram of emulgel in between slides that have bits of hairless rat skin on them. Applying pressure to a single glass slide causes the sandwich of two slides to separate. 200 mg of additional weight is added every minute until the skin's surface separates. The weight required to separate the emulgel from the skin will determine the bioadhesive strength. The formula used to calculate it is as follows:

Bio adhesive Strength = W / A
where A= Area (cm2) and W= Weight necessary (in gms)

5. Determination of Rheological Properties: A Brookfield viscometer with Spindle number S64 was used to measure the viscosity of 20g of prepared emulgel placed in a 25ml beaker.
6. Accelerated stability studies: In accordance with ICH recommendations, the formulations are maintained in an oven for three months at three distinct temperatures: 37±2, 45±2, and 60±2. Every two weeks, the drug content is assessed using the proper analytical technique. Measuring stability is dependent on the drug's breakdown or the gel's pH changing.
7. To calculate the percentage of drug content, combine 1 gram of produced emulgel with 25 milliliters of methanol. For thirty minutes, this resulting solution is sonicated. From this solution, the appropriate analytical procedure was used to assess the drug content.
8. Emulgel spreadability can be ascertained using the Slip and Drag method, which Mutimer recommended. To do this, take 2 grams of emulgel and apply it to the lower side slide that is mounted with a

wooden block. Next, prepare a sandwich by using another glass slide of the same size that is bound with a hook and has 500 milligrams of weight placed on it. Five minutes later, more weight was added to the pan that was attached to the second slide. The time it took to travel a distance of 5 cm for the upper slide was noted, and spreadability was computed using the formula below:

Spreadability (S) = M*L / T
Where, M = Weight tied to upper slide
L = Length of glass slides
T = Time taken to cover distance by upper slide

9. To test for skin irritation, apply 0.25 g of prepared emulgel to two to three separate places on a rabbit. After applying the solution for 24 hours, the rabbit's skin site is washed and wiped, and any unfavorable morphological changes are noted.

10. Diffusion experiments in vitro: A Franz diffusion cell is utilized to illustrate the diffusion study of a manufactured emulgel. 0.5g of sample is dispersed over a cellophane membrane, and diffusion is carried out using phosphate buffer (pH 7.4) for 8 hours at 37±1°C. One milliliter of sample is taken and replaced with brand-new buffer solution every hour. Appropriate analytical methods are used to examine the collected materials.

11. Determination of Skin Permeation: Differential scanning calorimetry (DSC) is used to examine the chemical and structural alterations in the epidermal layer. The study examines heat changes in rats' desiccated SC membranes to evaluate the penetration process use the DSC methodology. In order to guarantee reducing hydration to 20%, skin samples—both treated and untreated—were previously hydrated on a 27% Sodium-Br solution for at least 48 hours. Before being analyzed, the skin samples are kept in desiccators for three days at silica gel. Slice the skin layer into 4 mg weighted pieces, seal them in 10µL aluminum pans, and put them in the differential scanning calorimeter device with an empty pan for comparison. The nitrogen flow rate is changed to 20 ml/min, which equals.

Experimental data on gels and emulgels

Sr.no.	*Drug*	*Type*	*Polymer*	*Enhancer*	*Purpose*	*Reference*
1	Chlorphenisn	Emulgel	Carbopol-934,HPMC	Propylene glycol	Effect of gelling agent on release	8
2	Nimesulide	Gel	HPMC,Carbopol-940,Natural	Dimethyl sulfoxide	Effect of gelling agent on release	9
3	Ketoconazole	Emulgel	Carbopol-934,940	Propylene glycol	Comparative study of Polymer anddrug release	10
4	Fluconazole	Liposomal Gel	Carbopol-934	Cholestrol,stearic Acid	Increase permeation and deposition	11
5	Diclofenac	Gel & Emulgel	Carbobol-934.940 HPMC	Transcutol,Myrj52 Cineol	Effect of penetration Enhancer	12
6	Ketoprofen	Gel	Polaxamer407 Carbopol-934, Sod. CMC	Oleic acid	Effect of oleic acid on release	13
7	Mefanamic Acid	Emulgel	Carbobol-934,HPMCK4M	Cloveoil, mentha Oil	Release study and Pharmacologic	14

8	Ibuprofen	Gel	Chitosan	Menthol, glycerol	Study of topical and systemic effect	15
9	Meloxicam	Gel	Carbopol-934P	PEG-400 Menthol,azone	Effect of penetration enhancers	16
10	Itraconazole	Emulgel	Carbopol-934,940	Propylene glycol	More selective, safe	17
11	Veldecoxib	Gel	Carbopol-934,HPMC	Propylene glycol Ethanol	Effect of PG and ethanol on release	18
12	Miconazole	Emulgel	Carbopol-940,934	Propylene glycol	Controlled delivery	19
13	Aceclofenac	Gel	Carbopol, HPMC, Sod. CMC	Propylene glycol	Carbopol gel show superior release	20

RESULT:

The study emphasizes the importance of emulgels in topical drug delivery systems, paying particular attention to the procedures involved in their formulation and assessment. Emulgels solve issues with hydrophobic medications and help to increase drug absorption, stability, and controlled release by combining the benefits of emulsions and gels. The role of physiological parameters on medication absorption via the skin is highlighted, with particular attention paid to skin thickness, lipid profile, and pH. Important ingredients for emulgel formulation include the vehicle, emulsifiers, gelling agents, and penetration enhancers. Physicochemical factors are taken into account to ensure efficient drug delivery. Comprehensive evaluation techniques, from pH testing to diffusion studies, guarantee the stability and quality of emulgels. The experimental data displayed demonstrates the wide range of uses for emulgels in the delivery of different medications.

CONCLUSION:

In summary, emulgels offer a flexible platform for the formulation and distribution of a broad variety of pharmacological agents, making them a potential option in topical drug delivery. The effective distribution of both hydrophobic and hydrophilic medicines is made possible by the special mix of emulsion and gel characteristics. In order to maximize medication release and absorption, it is important to consider the formulation methods that have been addressed, such as the choice of suitable vehicles, emulsifiers, and penetration enhancers. Emulgels show great promise in resolving issues with conventional dosage forms, especially in applications related to dermatology. Furthermore, the thorough assessment techniques described in this research guarantee the stability and dependability of emulgel formulations. Emulgels have the potential to significantly improve drug delivery effectiveness, patient compliance, and overall therapeutic results as long as pharmaceutical research advances.

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