"Emulgel Formulations for Transdermal Drug Delivery: A Review of Recent Developments"

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ABSTRACT
The most common use of topical drug delivery is for local dermatological activity, although novel methods are being developed these days to improve the systemic effect as well. They are typically used as skin emollients, antifungal agents, antiseptics, and protectors. Topical preparation activity reveals several aspects, including drug solubility, skin contact time, lipophilicity, and permeability. Gels are a relatively recent sort of dosage form that are made by trapping huge volumes of hydroalcoholic or aqueous liquid within a network of colloidal solid particles. When compared to traditional topical medication delivery formulations, gel formulations typically offer faster drug release. Despite the many benefits of gels, one significant drawback is the challenge of delivering hydrophobic medications. In order to get around these restrictions, emulgels are made. Emulgels are the dosage forms that are created when gels and emulsions are mixed. Emulsions can be readily removed whenever wanted and have a certain beauty to them. The thixotropic, greaseless, easily spreadable, readily removable, emollient, nonstaining, long shelf life, bio-friendly, transparent, and aesthetically pleasant properties of emulgels are only a few of its many benefits in the field of dermatology. Emulgels are currently being utilized to administer a wide range of cosmetic formulations as well as analgesics, anti-inflammatory, anti-fungal, and anti-acne medications.

KEYWORDS: Topical Drug Delivery, Emulgel, Gel, Emulsion.

1. INTRODUCTION

Topically drug administration is a confined drug delivery system anywhere in the body through ophthalmic, rectal, vaginal and skin as topical routes. The main advantage of topical delivery system is to evade first pass metabolism.[1,2] Avoidance of the risks and inconveniences of parenteral therapy as well as varied conditions of absorption like changes in pH, presence of enzymes, gastric emptying time are other advantages of topical preparations.[3,4] Dermatological products are divers in formulation and varied in consistency from liquid to powder but the most popular products are semisolid preparation. Within the major group of semisolid preparations, the use of clear, translucent gels has expanded both in cosmetics and in pharmaceutical preparations. Gels are a somewhat newer class of dosage form formed by entrapment of large amounts of aqueous or hydro alcoholic liquid in a complex of colloidal solid particles. Gel formulations usually provide faster drug release as compared with traditional ointments and creams. Rather than the many advantages of gels a major limitation is the difficulty in delivery of hydrophobic drugs. To minimize this limitation emulgels are prepared so that even a hydrophobic drug can enjoy the unique properties of gels. When gels and emulsions are used in combined form the dosage forms are known as Emulgels. In fact, the presence of a gelling agent in the water phase converts a traditional emulsion into an emulgel. Oil-in-water system is used to entrap lipophilic drugs while hydrophilic drugs are captured in the water-in-oil system.[5] Emulsions possess a definite degree of elegance and are easily washable whenever required. They also have a high ability to cross the skin. Dermatological emulgels have several favourable properties such as thixotropic, easily spreadable, greaseless, easily removable, emollient, non-staining, longer shelf life, bio-friendly, transparent & pleasing appearance.[6]

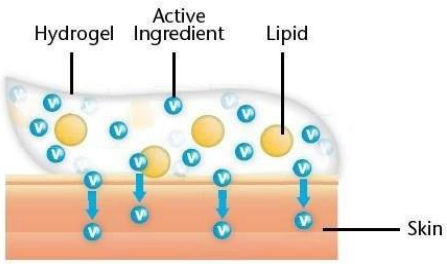


Figure 1: Structure of Emulgel**.**

1.1. Topical Drug Delivery System

Topical drug delivery system there are two basic types of topical drug delivery products, externally used topicals and internally used topicals. The externally used topicals are spread, sprayed or otherwise dispersed on the tissue to shield diseased area, while the internally used topicals are applied to mucous membrane orally, vaginally or on the rectal tissues for local activity. Main benefit of topical drug delivery system are avoiding first pass metabolism, avoiding gastrointestinal incompatibilities, specific site selective, improving patients compliance, possible and easy self-medication, and drugs with short half-life and narrow therapeutic index are also subjected to be utilized, facility is used to easily terminate medicines whenever required.[7] Disadvantages of topical drug delivery system are skin irritation on contact dermatitis, allergic reactions, poor drug permeability through skin, drugs of large particle size are not absorbed easily through skin. Skin is thick, complex in structure. Molecules moving from the external environs must penetrate the stratum corneum as well as any material of endogenous or exogenous origin on its surface. They must then penetrate the viable epidermis, the papillary dermis and the capillary walls into the blood stream or lymph compartment, where upon they are removed from the skin by flow of blood or lymph. To move across the skin membrane is obviously a complex process and challenge in analysis. Factors affecting the topical drug delivery system can be physiological factors e.g. thickness, hydration, inflammation and pH of skin, lipid content, densities of hair follicles and sweat glands, blood flow etc., and physico-chemical factors like partition coefficient, molecular weight, degree of ionization, effect of vehicle etc.[8] When moiety touches intact skin, it contacts cellular debris, microorganisms, sebum and the other materials. The diffusion of drug will be done by various routes via hair follicles, sebaceous gland and sweat ducts across the continuous stratum corneum.

1.2. RATIONALE OF EMULGEL AS A TOPICAL DRUG DELIVERY SYSTEM

There are many medicated products are applied to the skin or mucous membrane that either enhance or restore a fundamental function of skin or pharmacologically alter an action in the underlined tissues. Such products are referred as topical or dermatological products [21]. Many widely used topical agents like ointments, creams lotions 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 [22], 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.

1.3. ADVANTAGES OF USING EMULGELS AS A DRUG DELIVERY SYSTEM

1.3.1. Hydrophobic drugs can be easily incorporated in to gels using emulsions: Most of the hydrophobic drugs cannot be incorporated directly into gel base because solubility act as a barrier and problem arises during the release of the drug. Emulgel helps in the incorporation of hydrophobic drugs into the oil phase and then oily globules are dispersed in aqueous phase resulting in o/w emulsion. And this emulsion can be mixed into gel base. This may be proving better stability and release of drug than simply incorporating drugs into gel base [23, 24].

1.3.2. Production feasibility and low preparation cost: Preparation of emulgels comprises of simpler and short steps which increases the feasibility of the production. There are no specialized instruments needed for the production of emulgels. Moreover materials used are easily available and cheaper. Hence, decreases the production cost of emulgels.

1.3.3. Controlled release: Emulgels can be used to prolong the effect of drugs having shorter T1/2**.**

1.3.4. Patient compliance: They are less greasy and easy to apply.

1.3.5. No intensive sonication: Production of vesicular molecules needs intensive sonication which may result in drug degradation and leakage. But this problem is not seen during the production of emulgels as no sonication is needed.

1.3.6. Better loading capacity: Other novel approaches like niosomes and liposomes are of nano size and due to vesicular structures may result in leakage and result in lesser entrapment efficiency. But gels due to vast network have comparatively better loading capacity [25].

1.3.7. Better stability: Other transdermal preparations are comparatively less stable than emulgels. Like powders are hygroscopic, creams shows phase inversion or breaking and ointment shows rancidity due to oily base. [26-29].

2.0. FACTORS AFFECTING TOPICAL ABSORPTION OF FORMULATIONS[30-31]

2.1. Physiological Factors

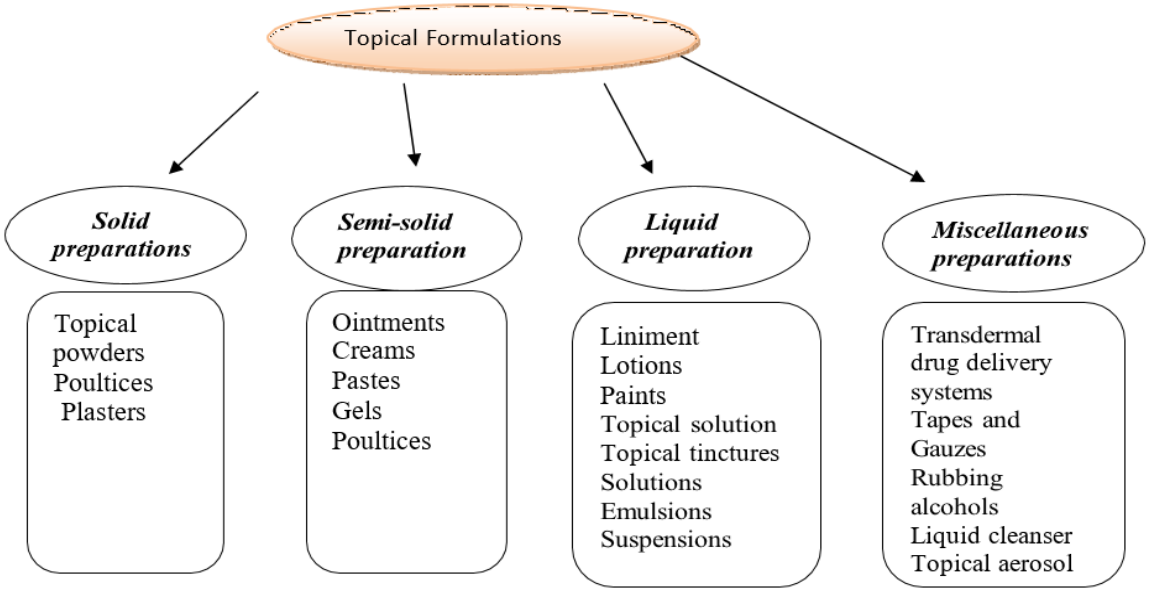
- Skin thickness.
- Skin pH.

- Hydration of skin
- Inflammation of skin
- Lipid content.
- Blood flow
- Density of hair follicles.
- Density of sweat glands.

2.2. Physiochemical Factors
- Partition coefficient.
- Molecular weight (<400 Dalton).
- Degree of ionization (only unionized drugs gets absorbed well).
- Effect of vehicles

2.3. FACTORS TO BE CONSIDERED WHEN CHOOSING A TOPICAL FORMULATION [32]
Effect of the vehicle e.g. an occlusive vehicle enhances penetration of the active ingredient and improves efficacy. The vehicle itself may have a cooling, drying, emollient, or protective action.
- Match the type of preparation with the type of lesions. For example, avoid greasy ointments for acute weepy dermatitis.
- Match the type of preparation with the site (e.g., gel or lotion for hairy areas).
- Irritation or sensitization potential, Generally,ointments and w/o creams are less irritating, while gels are irritating. Ointments do not contain preservatives or emulsifiers if allergy to these agents is a concern.
- The medication should not affect the skin type [33].

2.4. VARIOUS DOSAGE FORMS USED FOR TOPICAL DRUG DELIVERY SYSTEM [34]



3.0. FORMULATION OF EMULGELS:
3.1. Vehicles: The vehicle has following properties.
- Efficiently deposit the drug on the skin with even distribution.
- Release the drug so it can migrate freely to the site of action.
- Deliver the drug to the target site.
- Sustain a therapeutic drug level in the target tissue for a sufficient duration to provide a

3.2. Pharmacologic effect.
- Appropriately formulated for the anatomic site to be treated.
- Cosmetically acceptable to the patent.
- Due to the efficiency of the epidermal barrier, the amount of topical drug that gets through the stratum corneum is generally low. Rate and extent of absorption vary depending on characteristics of the vehicle but is also influenced by the active agent itself [35].

3.3. Aqueous Material: This forms the aqueous phase of emulsion. The commonly used agents are water, alcohols etc [36, 37].

3.4. Oils: For externally applied emulsions, mineral oils, either alone or combined with soft or hard paraffin, are widely used both as the vehicle for the drug and for their occlusive and sensory characteristics [38]. Widely used oils in oral preparations are non-biodegradable mineral and castor oils that provide a local laxative effect, and fish liver oils or various fixed oils of vegetable origin (e.g., arachis, cottonseed, and maize oils) as nutritional supplements. Some are discussed in table 1.

Table I: Use of Oils

Sr. No.	Chemical	Quantity	Dosage form	References
1	Isopropyl myristate	According to phase Diagrams	Emulsion	Subramanian, N. Drug Dev. Ind. harm.
2	CAPMUL	According to phase Diagrams	Emulsion	Subramanian, N. Drug Dev. Ind. Pharm
3	Isopropyl Myristate	7-7.5%	Emulsion	Montenegro, L., Drug Dev. Ind. Pharm
4	Isopropyl palmitate	7-7.5%	Emulsion	Montenegro, L., Drug Dev. Ind. Pharm
5	Isopropyl stearate	7-7.5%	Emulsion	Montenegro, L., Drug Dev. Ind. Pharm
6	Light Liquid Paraffin	7.5%	Emulsion	Mohamed, M.I.,AAPS
7	Light Liquid Paraffin	7.5%	Emulsion	Jain, Ankur. IJPRD
8	Propylene glycol	3-5%	Gel	Arellano, A., European J. Pharm. Sci.

3.5. Emulsifiers: Emulsifying agents are used both to promote emulsification at the time of manufacture and to control stability during a shelf life that can vary from days for extemporaneously prepared emulsions to months or years for commercial preparations e.g. Polyethylene glycol 40 stearate, Sorbitan mono-oleate (Span 80), Polyoxyethylene sorbitan monooleate (Tween 80), Stearic acid and Sodium stearate.

3.6. Gelling Agents: These are the agents used to increase the consistency of any dosage form can also be used as thickening agent given in table 2.

Table II: Use of Different Gelling Agents

Sr. No.	GELLING AGENT	QUANTITY	DOSAGE FORM	REFERENCES
1	Carbapol-934	1%	Emulgel	Mohamed, M.I.,AAPS
2	HMPC 2910	2.5%	Emulgel	Mohamed, M.I.,AAPS
3	Carbapol-940	1%	Emulgel	Jain, Ankur. IJPRD
4	Aegelmarmelos Polymer(natural)	1%	Gel	Kumar, L., Int. J. Drug Del.
5	Sodium CMC	1%	Gel	Singh, S., Pak J. Pharm. Sci.
6	Xanthan Gum	1%	Gel	Singh, S., Pak J. Pharm. Sci.
7	Poloxamer 407	1%	Gel	Singh, S., Pak J. Pharm. Sci.
8	HPMC	3.5%	Gel	Gupta, A., Drug Invention Today

3.7. Penetration Enhancers: In order to promote absorption of drugs, vehicles often include penetration enhancing ingredients that temporarily disrupts the skin barrier, fluidize the lipid channels between corneocytes, alter the partitioning of the drug into skin structures, or otherwise enhance delivery into skin So called penetration enhancers some of these materials given in table 3 [39].

Table III: Use of Penetration Enhancers

Sr. No.	Permeation Enhancers	QUANTITY	DOSAGE FORM	REFERENCES
1	Oleic Acid	1%	Gel	Mortazavi, S.A., Iranian Journal of Pharmaceutical Science
2	Lecithine	5%	Gel	Mortazavi, S.A., Iranian Journal of Pharmaceutical Science
3	Isopropyl myristate	5%	Gel	Mortazavi, S.A., Iranian Journal of Pharmaceutical Science
4	Urea	10%	Gel	Mortazavi, S.A., Iranian Journal of Pharmaceutical Science
5	Eucalyptus oil	NA	None	Pathan, I.B. , Trop J Pharm Res
6	Chenopodium oil	NA	None	Pathan, I.B. , Trop J Pharm Res
7	Pyrrolidones	NA	None	Pathan, I.B. , Trop J Pharm Res
8	Laurocapran	NA	None	Pathan, I.B. , Trop J Pharm Res
9	Dimethyl sulphoxides	NA	None	Pathan, I.B. , Trop J Pharm Res
10	Linoelic Acid	5%	Gel	Kasliwal, N., AJPS
11	Menthol	4-6%	NA	Shojaei, A.H., European Jounal of Pharmaceutics

4.0. METHOD OF PREPARATION: There are various methods of formulation of Emulgel, employing different kinds of ingredient.

- Chemical enhancement
- Physical enhancement.
- Biochemical enhancement
- Super saturation enhancement.

Research work (optimization of chlorphenesin in Emulgel) includes formation of emulsion (o/w or w/o), followed by addition of gelling agent to form Emulgel. Here first step involves formation of aqueous phase of emulsion. Aqueous phase of emulsion is prepared by first dissolving tween 20 in purified water, then solution of propylene glycol is prepared by dissolving methyl paraben and propyl paraben in propylene glycol and then both the solutions are mixed and set aside. Oily phase of emulsion is prepared by dissolving span 20 in light liquid paraffin. Formation of emulsion involves separate heating of oily and aqueous phase to 70–80 °C then both the phases are mixed with constant stirring until cooled to room temperature. Gel phase of Emulgel is prepared by dispersing HPMC or Carbopol in water. HPMC is required to soak overnight in water, while Carbopol gel is prepared by simply dispersing it in purified water. When both the components both emulsions & gel get ready then the Emulgel is prepared by mixing emulsion with gel in 1:1 ratio with gentle stirring [40]. Research work based on design & characterization of Emulgel for buccal administration. Here formulation of Emulgel involves three steps (1) polymer dispersion in water, (2) neutralization of the polymeric aqueous dispersion and (3) emulsification of the oil phase. With respect to the first step, three different TR-1 percentages, namely 0.3, 0.4 and 0.5%, w/v, are required. First step involves suspension of polymer in deionized water with continuous stirring at 900 rpm for
20 min at room temperature using a mechanical stirrer equipped with a three blade helical impellers & then slurry is neutralized with NaOH solution (18%w/v) to final pH value of 5.5, 6.0 and 6.5. The neutralization process causes the distension of polymer chains resulting in clear stable gels. Now for the complete hydration of polymer gels are required to be stored at 4 0C for 24 h before the addition of oil phase. After completing the hydration of gel different quantities of oil phase at three o/w ratio (w/w) 0.5, 1.0 and 1.5 respectively are added with stirring at 800 rpm (80 °C) there after it is left for cooling and its pH is measured [41]. Research work based on different methods to develop Emulgel for clotrimazole delivery. This method involves the preparation of oily phase of emulsion by dissolving drug and span 60 in oily phase (jojoba oil) with the aid of magnetic stirrer at 75 0C with subsequent cooling followed by addition of Carbopol to the oily phase. Secondly aqueous phase is prepared by dissolving Brij-35 in propylene glycol. Third step involves addition of oily phase to the aqueous phase following their emulsification using the over head mixer for 10 min at 1400 rpm, and then introducing emulsion into the homogenizer for 5 min at 10,000 rpm. Gellification of emulsion involves addition of gelling agent triethanolamine (formulae containing Carbopol either alone or in combination) and/or HPMC to the emulsion using over head mixer at 200 rpmfor 45 min thereby adjusting the pH of formulation containing Carbopol to 5.5–6.5 using TEA [42]. The flow chart of emulgel preparation is shown in figure 1.

These are the common steps to prepare the emulgel:
STEP 1: Formulation of Emulsion either O/W or W/O
STEP 2: Formulation of gel base
STEP 3: Incorporation of emulsion into gel base with continuous stirring.

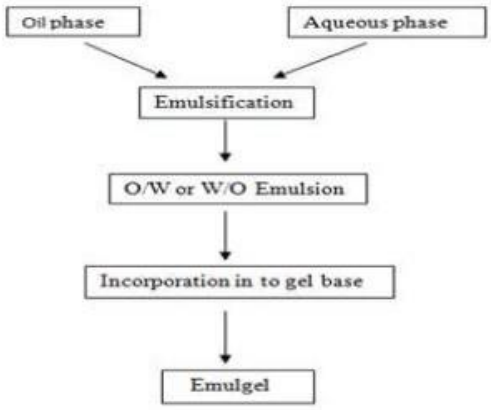


Figure 1: Common stages to prepare emulgels

5.0. CHARACTERIZATION AND EVALUATION OF EMULGELS

5.1. Physical Examination: The prepared emulgel formulations are inspected visually for their color, homogeneity, consistency and phase separation [43, 44].

5.2. Photo microscopy: Optimized batch of the emulgel was viewed under light microscope to study the globular structure in gel base. The emulgel was suitably diluted, mounted on glass slide and viewed by light microscope under magnification of 40.

5.3. Globule size: The globule size obtained was determined using Zetasizer (Malvern Instrument 3000HSA, UK). The sample was suitably diluted and the globule size was measured at 25 0C.

5.4. Rheological studies: The viscosity of the different emulgel formulations is determined at 25 0C using a cone and plate viscometer with spindle 52 (Brookfield Engineering Laboratories,) and connected to a thermostatically controlled circulating water bath [45].

5.5. Determination of Ph: The pH measurements were done using a digital pH meter (Thermo scientific) which was calibrated with standard buffer solutions. The measurements of pH of each system were replicated three times [46].

5.6. Determination of viscosity: The viscosity of the prepared formulations was determined at ambient temperature using Brookfield digital viscometer (DV-II +Pro) with spindle no. 96 at 0.1, 0.5, 1 and 1.5 rpm.

5.7. Determination of thixotropic characteristics: The formulations were subjected to different rates of shear using GEMINI 200: Rheometer, at constant temperature (250C).the measuring system employed was the cone and plate system having 40 mm diameter and 40 angles. The rheogram was constructed by plotting rate of shear against shear stress.

5.8. 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. Then samples were removed from beakers at different time intervals and put it on dry place for some time after it reweighed [47].

Swelling index is calculated as follows:
Swelling Index (SW) (SW) % = [(Wt – Wo) / Wo] × 100.
Where, (SW) % = Equilibrium percent swelling,
Wt = Weight of swollen emulgel after time t, Wo = Original weight of emulgel at zero time.

5.9. Spreading Coefficient: Spreadibility is determined by apparatus 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 end. By this method, spreadibility 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 min 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 80 gm. 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 indicates better spread ability [48, 49].

5.10. Drug Content Determination: Take 1gm of emulgel. Mix it in suitable solvent. Filter it to obtain clear solution. Determine its absorbance using UV spectrophotometer. Standard plot of drug is prepared in same solvent. Concentration and drug content can be determined by using the same standard plot by putting the value of absorbance [50].Drug Content = (Concentration × Dilution Factor × Volume taken) × Conversion Factor.

5.11. Skin Irritation Test (Patch Test): The preparation is applied on the properly shaven skin of rat and its adverse like change in color, change in skin morphology should be checked up to 24 h. The total set of 8 rats can be used of the study. If no irritation occurs the test is passed. If the skin irritation symptom occurs in more than 2 rats the study should be repeated [51].

5.12. Extrudability Study of Topical Emulgel (Tube Test): 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 10s. More quantity extruded better is extrudability. The measurement of extrudability of each formulation is in triplicate and the average values are presented [52].

The extrudability is than calculated by using the following formula:
Extrudability = Applied weight to extrude emulgel from tube (in gm) / Area (in cm2).

5.13. Ex–Vivo Bioadhesive Strength Measurement of Topical Emulgel: (Mice Shaven Skin) The modified method is used for the measurement of bioadhesive 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 min. Weight is added slowly at 200 mg/ min to the left – hand pan until the patch detached from the skin surface. The weight (gm force) required to detach the emulgel from the skin surface gave the measure of bioadhesive strength [53].

The bioadhesive strength is calculated by using following:
Bioadhesive Strength = Weight required (in gm) / Area (cm2).

5.14. In Vitro Release/Permeation studies: In vitro release studies were carried out using Franz diffusion cell [54].
Stability studies: The prepared emulgels were packed in aluminium collapsible tubes (5 g) and subjected to stability studies at 5°C, 25°C/ 60% RH, 30°C/65% RH, and 40°C/75% RH for a period of 3 months. Samples were withdrawn at 15-day time intervals and evaluated for physical appearance, pH, rheological properties, drug content, and drug release profiles [55, 56].

6.0. MARKETED PREPARATIONS: Some preparations of Emulgel are commercially available in markets which are listed as following in Table 4.

Table IV: Marketed Emulgel Preparations

Sr. No.	Drug	Product Name	Manufacturer
1	Miconazole nitrate, Hydrocortisone	Miconaz-H-emulgel	Medical union Pharmaceuticals
2	Diclofenac diethyl ammonium	Voltaren emulgel	Novartis Pharma
3	Metronidazole	Lupigyl gel	Lupin Pharma
4	Clindamycin, Adapalene	Excex gel	Zee laboratories
5	Benzoyl peroxide	Pernox gel	Cosme Remedies Ltd
6	Aceclofenac, Methyl salisylate,Capsaicin	Acent gel	Intra labs India Pvt Ltd
7	Kojic acid, Dipalmitate Arbutin, Octinoxate	Kojivit gel	Micro Gratia Pharma
8	Clobetasol propionate	Topinate gel	Systopic Pharma
9	Clindamycin phosphate Allantoin	Clinagel	Stiefel Pharma
10	Tezarotene	Zorotene gel	Elder Pharmaceuticals
11	Clotrimazole, Beclomethasone Dipropionate, Neomycin	Cloben gel	Indoco Remedies
12	Nadifloxacin	Nadicin cream	Psychoremedies
13	Azithromycin	Avindo gel	Cosme Pharma laboratories

7.0. FUTURE PROSPECTS
Hydrophobic behavior of drugs is one of the most common problems faced during formulation & development of any new formulation. This behavior is responsible for poor water solubility and bioavailability of drugs. Many numbers of drugs are hydrophobic in nature and its delivery to the biological system has been challenging. For topical delivery of drugs different delivery systems such as ointments, lotion, creams and pastes are applied. These topical formulations generally include large number of oleaginous bases such as petrolatum, bees wax or vegetable oils that themselves are hydrophobic in nature that do not allow the inclusion of water or aqueous phase.
It makes them an excellent emollient but retards the release of drugs and makes the product thick & greasy. Whereas gel provides aqueous environment to drug, favors its dissolution and provides quicker release of drug as compared to other topical delivery systems. Emulsion based gel provides a suitable medium for delivery of such hydrophobic drugs where such drugs can be incorporated into its oily phase and delivered to skin. All such advantages of Emulgel over other topical delivery systems make them more efficient & productive. In future these properties will be used to deliver more number of topical drugs in the form of Emulgel.

7.0. CONCLUSION
After the vast study, it can be concluded that the emulgels appear better & effective drug delivery system as compared to other topical drug delivery system. The comprehensive analysis of rheological and release properties will provide an insight into the potential usage of Emulgel formulation as drug delivery system. As the emulgel is the recent trend for topical drug delivery system. Obviously it is a very good approach for drug delivery of combination of hydrophilic and hydrophobic drugs. In future, topical drug delivery will be used extensively to impart better patient compliance. Since emulgel possesses an edge in terms of spreadibilty, adhesion, viscosity and extrusion, they will become a popular drug delivery system. Moreover, they will become a solution for loading hydrophobic drugs in a water soluble gel bases.

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