EMULGELS: A COMPREHENSIVE REVIEW INCLUDING PATENTS

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ABSTRACT

Topical drug delivery is an attractive route for local and systemic treatment. Topical drug administration is a localized drug delivery system anywhere in the body through ophthalmic, rectal, vaginal and skin as topical routes. Major drawback of topical dosage form is dissolution and diffusion of drug in the delivery of hydrophobic drugs, and permeation through stratum corneum is for hydrophilic drugs. Therefore, to overcome this limitation, emulgels are prepared. The combined dosage form of gels and emulsions are referred as emulgels. Emulgels are a relatively newer class of dosage form created by entrapment of large amounts of aqueous or hydro alcoholic liquid in a network of colloidal solid particles, which may consist of inorganic substances, such as aluminum salts or organic polymers of natural or synthetic origin. Emulgels have the major advantages on novel vesicular systems as well as on conventional systems in various emollient, non staining, water soluble, comedogenic and bio friendly. Use of penetration enhancers such as clove oil, menthol, oleic acid, etc. enhances the effect. These emulgels are packaged with membrane sealed lacquered tube with a propylene screw cap. Voltren, voveren, voltrol and many more are the various marketed preparations of the emulgel used widely today. This review concise the detail on the basics of emulgel, preparation, required penetration enhancers, factors affecting, evaluation methods and patents related to the emulgel.
KEYWORDS: Topical drug delivery, emulgels, penetration, patents.

INTRODUCTION
Topical drug delivery can be defined as the application of a drug containing formulation to the skin to directly treat cutaneous disorder. Topical drug administration is a localized drug delivery system anywhere in the body through ophthalmic, rectal, vaginal and skin as topical routes. These apply a wide spectrum of preparations for both cosmetic and dermatological to their healthy or diseased skin. Topical drug delivery is an attractive route for local and systemic treatment. A unique aspect of dermatological pharmacology is the direct accessibility of the skin as a target organ for diagnosis and treatment. [1] Topical drugs must be of low molecular mass (600 Daltons), with adequate solubility in oil and water, and have high partition coefficient for the topical formulation. Major drawback of topical dosage form is dissolution and diffusion of drug in the delivery of hydrophobic drugs, and permeation through stratum corneum is for hydrophilic drugs. Therefore, to overcome this limitation, emulgels are prepared. The combined dosage form of gels and emulsions are referred as emulgels. Both oil-in-water and water-in-oil emulsions are extensively used as vehicles to deliver various hydrophilic as well as hydrophobic drugs to the skin in emulgel formulation. They also have a high ability to dissolve drug and to penetrate the skin. Oil-in-water emulsions are mostly useful as water washable drug bases and for general cosmetic purposes, while water-in-oil emulsions are employed more widely for the treatment of dry skin and emollient applications. Emulgels are a relatively newer class of dosage form created by entrapment of large amounts of aqueous or hydro alcoholic liquid in a network of colloidal solid particles, which may consist of inorganic substances, such as aluminum salts or organic polymers of natural or synthetic origin. [2]

![Fig 1: Physical Appearance of Gel and Emulgel.][3]
For dermatological use Emulgels show several favorable properties such as being thixotropic, greaseless, easily spreadable, easily removable, emollient, non-staining, long shelf life, biofriendly, transparent & pleasing appearance. Use of topical agents requires an appreciation of the factors that influence percutaneous absorption. Voltrol, Voveran, Voltaren are the various available marketed emulgel formulations.

**ADVANTAGES OF EMULGEL**

1. Incorporation of hydrophobic drugs.
2. Better loading capacity.
4. Production feasibility and low preparation cost.
5. Controlled release.
6. No intensive sonication.\[^4\]
7. Avoidance of first pass metabolism.
9. More selective to a specific site.
10. Improve patient compliance and suitability for self medication.
12. Ability to easily terminate medication when needed.\[^1\]

**DISADVANTAGES OF EMULGEL**

1. Skin irritation of contact dermatitis may occur due to the drug and/or excipients.
2. Poor permeability of some drugs through the skin.
3. Possibility of allergenic reactions.
4. Drugs of larger particle size not easy to absorb through the skin.\[^1\]
5. Enzyme in epidermis may denature the drugs.\[^5\]

**CLASSIFICATION OF TOPICAL DELIVERY**

Topical Delivery Includes Two Basic Types of Products.

- External topical that are spread, sprayed or otherwise dispersed on to cutaneous tissues to cover the affected area such as ointments, creams, liniments, etc.
- Internal topical that are applied to the mucous membrane orally, vaginally or on a rectal tissues for local activity such as emulsions, solutions, suspensions, suppository, etc.\[^4\]
Topical drug delivery system can also be classified on the basis of type of dosage form:

![Classification of Topical Preparations](image)

**Fig2: Classification of Topical Preparations.**[6]

**RATIONALE OF EMULGEL AS A TOPICAL DRUG DELIVERY SYSTEM**

So many formulations is applied to the skin or mucous membrane that either improves or repairs a fundamental function of skin or pharmacologically alters an action in the underlined tissues. Such products are referred as topical or dermatological products. 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. 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 fibres built from a small amount of a gelling 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.[7]

**PHYSIOLOGY OF SKIN**

Most of the topical preparations are meant to be applied to the skin. So, basic knowledge of the skin and its physiology function are very important for designing topical. The skin of an average adult body covers a surface area approximately 2 m² and receives about one third of the blood circulating through the body. An average human skin surface is known to contain, the average 40-70 hair follicles and 200-300 sweat ducts on every square centimeter of the
skin. The pH of the skin varies from 4 to 5.6. Sweat and fatty acid secreted from sebum influence the pH of the skin surface. The skin can be considered to have four distinct layers of tissue as shown in figure.

![Figure 3: Physiology of skin.](image)

1) **Non-viable epidermis**  
Stratum corneum is the outer most layer of skin, which is the actual physical barrier to most substance that comes in contact with the skin. The stratum corneum is 10 to 20 cell layer thick over most of the body. Each cell is a flat, plate like structure 34-44 μm long, 25-36 μm wide, 0.5 to 0.20 μm thick – with surface area of 750 to 1200 μm stocked up to each other in brick like fashion. Stratum corneum consists of lipid (5-15%) including phospholipids, glycosphingo lipid, cholesterol sulfate and neutral lipid, protein (75-85%) which is mainly keratin.

2) **Viable epidermis**  
This layer of the skin resides between the stratum corneum and the dermis and has a thickness ranging from 50-100 μm. The structures of the cells in the viable epidermis are physiochemically similar to other living tissues. Cells are held together by tonofibrils. The density of this region is not much different than water. The water content is about 90%.

3) **Dermis**  
Just beneath the viable epidermis is the dermis. It is a structural fibrin and very few cells are like it can be found histological in normal tissue. Dermis thickness ranges from 2000 to 3000μm and consists of a matrix of loose connective tissue composed of fibrous protein embedded in an amphorphose ground substance.
4) Subcutaneous connective tissue
The subcutaneous tissue or hypodermis is not actually considered a true part of the structured connective tissue which is composed of loose textured, white, fibrous connective tissue containing blood and lymph vessels, secretary pores of the sweat gland and cutaneous nerves. Most investigators consider drug permeating through the skin enter the circulatory system before reaching the hypodermis, although the fatty tissue could serve as a depot of the drug.\[^5\]

**DRUG DELIVERY ACROSS THE SKIN**
The epidermis is the most superficial layer of the skin and is composed of stratified keratinised squamous epithelium which varies in thickness in different parts of the body. It is thickest on with elastic fibers. The skin forms a relatively waterproof layer that protects the deeper and more delicate structures. Blood vessels are distributed profusely beneath the skin. Especially important is a continuous venous plexus that is supplied by inflow of blood from the skin capillaries. In the most exposed areas of the body—the hands, feet, and ears blood is also supplied to the plexus directly from the small arteries through highly muscular arteriovenous anastomoses. A unique aspect of dermatological pharmacology is the direct accessibility of the skin as a target organ for diagnosis and treatment. The skin acts as a two-way barrier to prevent absorption or loss of water and electrolytes. There are three primary mechanisms of topical drug absorption:

- Transcellular.
- Intercellular.
- Follicular.

![Fig 4: Pathway of Permeation through Skin.][22]
Most drugs pass through the torturous path around corneocytes and through the lipid bilayer to viable layers of the skin. The next most common (and potentially under-recognized in the clinical setting) route of delivery is via the pilosebaceous route. The barrier resides in the outermost layer of the epidermis, the stratum corneum, as evidenced by approximately equal rates of penetration of chemicals through isolated stratum corneum or whole skin. Creams and gels that are rubbed into the skin have been used for years to deliver pain medication and infection fighting drugs to an affected site of the body. These include, among others, gels and creams for vaginal yeast infections, topical creams for skin infections and creams to soothe arthritis pain. New technologies now allow other drugs to be absorbed through the skin (transdermal). These can be used to treat not just the affected areas (for example, the skin) but the whole body (systemic).[5]

**FACTORS AFFECTING TOPICAL ABSORPTION OF DRUG**

Physiochemical factors related to drug and physiological factors related to patient that affect the permeation of drug through stratum corneum are listed below.

**Physiological Factors**

1. Skin thickness
2. Lipid content
3. Density of hair follicles
4. Density of sweat glands
5. Skin pH
6. Blood flow
7. Hydration of skin
8. Inflammation of skin

**Physiochemical Factors**

1. Partition coefficient
2. Molecular weight (<400 Dalton)
3. Degree of ionization (only unionized drugs gets absorbed well)
4. Effect of vehicles.[4]
FACTORS TO BE CONSIDERED WHEN CHOOSING A TOPICAL PREPARATION
1. 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.
2. Match the type of preparation with the type of lesions. For example, avoid greasy ointments for acute weepy dermatitis.
3. Match the type of preparation with the site (e.g., gel or lotion for hairy areas).
4. 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.
5. The medication should not affect the skin type.[7]

METHOD TO ENHANCED DRUGS PENETRATION AND ABSORPTION
1. Chemical enhancement.
2. Physical enhancement.
4. Super-saturation enhancement.[7]

MATERIAL USED FOR THE PREPARATION OF EMULGELS
1) Vehicle
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 pharmacologic effect.
- Appropriately formulated for the anatomic site to be treated.
- Cosmetically acceptable to the patient.
- 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.[4]
2) Aqueous phase material
This forms the aqueous phase of the emulsion. Commonly used agents e.g. water, alcohols.

3) Oily phase materials
These agents form the oily phase. For externally applied emulsions, mineral oils, either alone or combined with soft or hard paraffin’s are widely used. In oral preparations 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.

Table 1: Uses of Oils in Different Dosage Forms.\(^{[1]}\)

<table>
<thead>
<tr>
<th>CHEMICAL</th>
<th>QUANTITY</th>
<th>DOSAGE FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light liquid paraffin</td>
<td>7.5%</td>
<td>Emulsion and Emulgel</td>
</tr>
<tr>
<td>Isopropyl stearate</td>
<td>7-7.5%</td>
<td>Emulsion</td>
</tr>
<tr>
<td>Isopropyl myristate</td>
<td>7-7.5%</td>
<td>Emulsion</td>
</tr>
<tr>
<td>Isopropyl palmitate</td>
<td>7-7.5%</td>
<td>Emulsion</td>
</tr>
<tr>
<td>Propylene glycol</td>
<td>3-5%</td>
<td>Gel</td>
</tr>
</tbody>
</table>

4) Emulsifier
Emulsifying agents are used both to promote emulsification at the time of manufacture and to control stability during a shelf life. e.g. Polyethylene glycol 40 stearate, Sorbitan mono-oleate (Span 80), Polyoxyethylene sorbitan monooleate (Tween 80), Stearic acid, Sodium stearate.

5) Preservatives
  e.g. Propyl paraben, methyl paraben, Benzalkonium chloride, Benzoic acid, Benzyl alcohol etc.

6) Antioxidants
  e.g. Butylated Hydroxy Toluene(BHT), Ascorbyl palmitate, Butylated hydroxyanisole(BHA), etc.

7) Humectant
  e.g. Glycerin, Propylene glycol, etc.

8) Gelling agents
  These are the agents used to increase the consistency of any dosage form can also be used as thickening agent. e.g. Carbapol 934, carbapol 940, HPMC, HPMC-2910, sodium CMC.\(^{[7]}\)
Table 2: Uses of Different Gelling Agents.\[^{[8]}\]

<table>
<thead>
<tr>
<th>GELLING AGENT</th>
<th>QUANTITY</th>
<th>DOSAGE FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbopol-934</td>
<td>1%</td>
<td>Emulgel</td>
</tr>
<tr>
<td>Carbopol-940</td>
<td>1%</td>
<td>Emulgel</td>
</tr>
<tr>
<td>HPMC-2910</td>
<td>2.5%</td>
<td>Emulgel</td>
</tr>
<tr>
<td>Sodium CMC</td>
<td>1%</td>
<td>Gel</td>
</tr>
<tr>
<td>Poloxamer 407</td>
<td>1%</td>
<td>Gel</td>
</tr>
<tr>
<td>HPMC</td>
<td>3.5%</td>
<td>Gel</td>
</tr>
</tbody>
</table>

Table 3: Different Grades of Carbopol along with their Properties.\[^{[8]}\]

<table>
<thead>
<tr>
<th>POLYMER</th>
<th>VISCOSITY</th>
<th>PROPERTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbopol 910</td>
<td>3000-7000</td>
<td>Effective in low concentration and will provide a low viscosity formulation</td>
</tr>
<tr>
<td>Carbopol 934</td>
<td>30, 500-39, 400</td>
<td>Effective in thick formulations such as emulsions, suspensions, sustain release formulation, transdermals and topical forms clear gels with water.</td>
</tr>
<tr>
<td>Carbopol 934 P</td>
<td>29, 400-39, 400</td>
<td>Same properties as 934 , but intended for pharmaceutical formulation purified water.</td>
</tr>
<tr>
<td>Carbopol 940</td>
<td>40, 000-60, 000</td>
<td>Effective in thick formulation, very good clarity in water or hydroalcoholic topical gels. Forms clear gels with hydroalcoholic system.</td>
</tr>
<tr>
<td>Carbopol 940</td>
<td>4000-11,000</td>
<td>Produces low viscosity gels, very good clarity</td>
</tr>
</tbody>
</table>

8) Permeation enhancer

These are agents that partition into and interact with skin constituents to induce a temporary and reversible increase in skin permeability. e.g. Oleic acid, lecithin isopropyl myristate, urea, eucalyptus oil, chenopodium oil, pyrrolidone, laurocapran, dimethyl sulphoxide, linoelic acid, menthol.

Table 4: Types of Penetration Enhancers used in different Dosage Forms.\[^{[1]}\]

<table>
<thead>
<tr>
<th>PENETRATION ENHANCERS</th>
<th>QUANTITY</th>
<th>DOSAGE FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>10%</td>
<td>Gel</td>
</tr>
<tr>
<td>Clove oil</td>
<td>8%</td>
<td>Emulgel</td>
</tr>
<tr>
<td>Menthol</td>
<td>5%</td>
<td>Emulgel</td>
</tr>
<tr>
<td>Oleic acid</td>
<td>1%</td>
<td>Gel</td>
</tr>
<tr>
<td>Lecithin</td>
<td>5%</td>
<td>Gel</td>
</tr>
<tr>
<td>Isopropyl myristate</td>
<td>5%</td>
<td>Gel</td>
</tr>
<tr>
<td>Linoleic acid</td>
<td>5%</td>
<td>Gel</td>
</tr>
<tr>
<td>Chenopodium oil</td>
<td>NA</td>
<td>None</td>
</tr>
<tr>
<td>Eucalyptus oil</td>
<td>NA</td>
<td>None</td>
</tr>
</tbody>
</table>
Properties of penetration enhancer

- They should be non-toxic, non-irritating and non-allergenic.
- They would ideally work rapidly and the activity and duration of effect should be both predictable and reproducible.
- They should have no pharmacological activity within the body i.e. should not bind to receptor sites.
- The penetration enhancers should work unidirectional i.e. it should allow therapeutic agent into the body whilst preventing the loss of endogenous material from the body.
- The penetration enhancers should be appropriate for formulation into diverse topical preparations, thus should be compatible with both excipients and drugs.
- They should be cosmetically suitable with an appropriate skin ‘feel’.\(^1\)

Mechanism of penetration enhancer:

Penetration enhancers may act by one or more of three main mechanisms:

1. Disruption of the highly ordered structure of stratum corneum lipid.
2. Interaction with intercellular protein.
3. Improved partition of the drug, co enhancer or solvent into the stratum corneum.\(^5\)

METHOD OF PREPARATION OF EMULGELS

Step 1

Oil/water emulsion

Drug is incorporated into either oil or aqueous phase depending upon its solubility.

Step 2

Formation of gel base.

Step 3

Incorporation of emulsion in gel base.

![Fig 4: Method of Preparation of Emulgel.\(^2\)](image-url)
Preparation of gel phase
The gel phase in the formulations is prepared by dispersing polymer in purified water with constant stirring at a moderate speed using mechanical shaker, then the pH was adjusted to 6–6.5 using tri ethanolamine (TEA).

Preparation of oil phase of emulsion
Oil phase of the emulsion is prepared by dissolving emulsifier e.g. span 20 in oil phase like light liquid paraffin.

Preparation of aqueous phase
The aqueous phase is prepared by dissolving emulsifier e.g. tween 20 in purified water.

Preparation of drug solution
The drug is dissolved in ethanol.[5]

CHARACTERIZATION OF EMULGEL
1. Physical Examination
The emulgel formulations should be inspected visually for their color, homogeneity, consistency and phase separation.

2. Rheological Studies
The viscosity of the different emulgel formulations should be characterized at 25°C using a cone and plate viscometer.

3. Spreading Coefficient
One of the criteria for a Gellified Emulsion to meet the ideal quantities is that it should possess good spreadability. It is the term expressed to denote the extent of area to which gel readily spread on application to skin or affected part. The therapeutic efficacy of a formulation also depends upon its spreading value. Spreadability is expressed in terms of time in seconds taken by two slides to slip off from emulgel and placed in between the slides under the direction of certain load. Lesser the time taken for separation of two slides, better the spreadability. It is calculated by using the formula.

\[ S = \frac{M \times L}{T} \]

Where M = wt. tied to upper slide
L = length of glass slides
T = time taken to separate the slides.
4. 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 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)

5. Swelling Index
It is the determination of the swelling capacity of the polymer i.e. amount of liquid material that can be absorbed. This can be done by two methods beaker test method and tea bag test method. (http://en.m.wikipedia.org) (19).

In a beaker test method, topical emulgel should be taken on porous aluminum foil and then place separately in a beaker containing 0.1 N NaOH. The samples are removed from beakers at different time intervals and are placed on dry place for some time and are weight again. Swelling index is calculated as follows:
Swelling index (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.

6. Drug Content Determination
Drug concentration in Gellified emulsion should be estimated by spectrophotometry. Drug content in Gellified emulsion is estimated measured by dissolving known quantity of gellified emulsion in solvent (methanol) by sonication. Absorbance after suitable dissolution is measured at desired wavelength in UV/ visible spectrophotometer.
Drug Content = (Concentration × Dilution Factor × Volume taken) × Conversion Factor
7. Skin Irritation Test (Patch Test)
The preparation should be applied on the properly shaven skin of rat and its adverse like change in color, change in skin morphology should be checked upto 24 hours. 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.

8. In Vitro Release/Permeation Studies
In vitro release studies are usually carried out using Franz diffusion cell.

9. Stability Studies
The prepared emulgels are generally packed in aluminum collapsible tubes 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.\[9\]

PACKAGING OF EMULGELS
Packaging of emulgels are usually done in membrane sealed lacquered aluminum tube with inner coating of a phenoxy-epoxy based lacquer closed with propylene screw cap or an aluminum laminated tubes closed by a moulded seal, with a propylene screw cap. (Public Assessment Report of Voltaren Emulgel).

These laminate tubes give the benefit of aluminum tube properties with the appearance of plastic. The “New Generation” of laminates tubes uses the modern technology to produce the tube with maximum space for graphics. Laminate material prevents the transfer of light, air and moisture. It consists of two layers: aluminum layer providing integrity and shelf appealing plastic tubes. The protective barrier serves various functions as they provide high gloss protective lacquer, resistant barrier for products requiring maximum compatibility along with the flavor and fragrance protection with the reduced absorption.

Material for laminates tubes
1. Foil laminates
   a. It provides light, air and moisture barrier.
   b. It reduces the aroma (flavor and fragrance) absorption.
   c. It has aluminum properties with the look and feel of plastic.
2. All plastic laminates
   a. It has a chemical resistant barrier.
   b. It offers the plastic like appearance and feel.
   c. It retains the shape and form.
   d. It has both opaque and transparent appearance.\cite{17}, \cite{18}

![Fig 5: (a) Foil laminates (b) Plastic laminates.\cite{17}, \cite{18}]

PATENT RELATED TO EMULGEL PREPARATIONS

Below mentioned are the various formulations which have been patented from last 20 years.

Table 5: List of patents.\cite{10}, \cite{11}, \cite{12}, \cite{13}, \cite{14}, \cite{15}, \cite{16}

<table>
<thead>
<tr>
<th>S.NO</th>
<th>PATENT NO</th>
<th>APPLICATION NO</th>
<th>TITLE OF PATENT</th>
<th>INVENTORS</th>
<th>YEAR</th>
</tr>
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<tbody>
<tr>
<td>2</td>
<td>EP2019666 A2</td>
<td>EP20070734379</td>
<td>Pharmaceutical preparations for transdermal use</td>
<td>Cristina Cavallari, Barbara Luppi, Pietra Anna Maria Di, Lorenzo Rodriguez</td>
<td>2009</td>
</tr>
<tr>
<td>3</td>
<td>2007129162</td>
<td>PCT/IB2007/001061</td>
<td>Pharmaceutical preparations for transdermal use</td>
<td>Cristina Cavallari, Barbara Luppi, Pietra Anna Maria Di, Lorenzo Rodriguez</td>
<td>1999</td>
</tr>
<tr>
<td>5</td>
<td>US 6004566 A</td>
<td>US 08/036, 116</td>
<td>Topical and transdermal delivery system utilizing submicron oil spheres</td>
<td>Doron Friedman, Joseph Schwartz, Haim Aviv</td>
<td>2007</td>
</tr>
<tr>
<td>6</td>
<td>5639738x</td>
<td>08/466,778</td>
<td>Topical composition containing hyaluronic acid and NSAIDs</td>
<td>Falk, Rudolf Edgar, Asculai, Samuel Simon</td>
<td>1995</td>
</tr>
<tr>
<td>7</td>
<td>US 6113921 A</td>
<td>US 09/006, 446</td>
<td>Topical and transdermal delivery system utilizing submicron oil spheres</td>
<td>Doron Friedman, Joseph Schwartz, Haim Aviv</td>
<td>1993</td>
</tr>
</tbody>
</table>
MARKETED PREPARATIONS OF EMULGEL[6]

There are various emulgel formulations which have been marketed and are used enormously and are enlisted in the table below.

Table 6: Various Marketed Preparations of Emulgel with their Manufacturers.

<table>
<thead>
<tr>
<th>PRODUCT NAME</th>
<th>API</th>
<th>MANUFACTURER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltren emulgel</td>
<td>Diclofenac diethyl ammonium</td>
<td>Novartis Pharma</td>
</tr>
<tr>
<td>Miconaz-H-emulgel</td>
<td>Miconazole Nitrate, Hydrocortisone</td>
<td>Medical union Pharmceutical</td>
</tr>
<tr>
<td>Excex gel</td>
<td>Clindamycin adapalene</td>
<td>Zee laboratories</td>
</tr>
<tr>
<td>Pernox gel</td>
<td>Benzoyl peroxides</td>
<td>Cosme Remedies Ltd</td>
</tr>
<tr>
<td>Lupigyl gel</td>
<td>Metronidazole</td>
<td>Lupin Pharma</td>
</tr>
<tr>
<td>Clinagel</td>
<td>Clindamycin phosphate, Alloantoin</td>
<td>Stiefel Pharma</td>
</tr>
<tr>
<td>Zorotene gel</td>
<td>Tezaratene</td>
<td>Elder Pharma</td>
</tr>
<tr>
<td>Topinate gel</td>
<td>Clobetasol propionate</td>
<td>Systopic Pharma</td>
</tr>
<tr>
<td>Nadicin cream</td>
<td>Nadifloxacin</td>
<td>Psychoremedies</td>
</tr>
<tr>
<td>Kojjivit gel</td>
<td>Kojic acid, Dipalmiate arbuti</td>
<td>Micro Gratia Pharma</td>
</tr>
<tr>
<td>Cloben gel</td>
<td>Clotrimazole, Beclomethasone</td>
<td>Indoco remedies</td>
</tr>
<tr>
<td>Acent gel</td>
<td>Acelofenac</td>
<td>Intra labs India Pvt Ltd</td>
</tr>
</tbody>
</table>

Figure 6: Various available marketed preparations emulgel. [23], [24], [25]

REFERENCES


20. Public assessment report of the medicines evaluation Board in the Netherlands. Voltaren Emulgel 1.16% gel, gel 11.6mg/g. Novartis consumer Health B.V., the Netherlands.


