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EMULGEL: MODERN TOOL FOR TOPICAL DRUG DELIVERY

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ABSTRACT
Topical drug delivery is most widely employed for the local dermatological action, but now a day's new techniques are also utilized to enhancing its systemic effect. They are generally adopted for the purpose as antiseptics, antifungal agents, skin emollients, and protective. The activity of topical preparation reveal the various factors as drug solubility, contact time to skin, its lipophilicity, its permeability. Gels are a quite newer class of dosage form formulated by entrapment of large amounts of aqueous or hydro-alcoholic liquid within the network of colloidal solid particles. Gel formulations generally provide faster drug release as compared to conventional topical drug delivery formulations. In spite of many advantages of gels, a major limitation is in the difficulty in delivery of hydrophobic drugs. So to overcome these limitations, emulgels are prepared. When gels and emulsions are used in combined form, the dosage forms are known as Emulgels. Emulsions have a certain degree of elegance and they are easily washed off whenever desired. Emulgels have numerous advantages in the area of dermatology such as being thixotropic, greaseless, easily spreadable, easily removable, emollient, nonstaining, long shelf life, bio-friendly, transparent and pleasing appearance. Emulgel are being used for the delivery of analgesics, anti-inflammatory, anti-fungal, anti-acne drugs and various cosmetic formulations with still wide range to explore.

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

INTRODUCTION

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. These formulations range in physicochemical nature from solid through semisolid to liquid.[1] Avoidance of the risks and inconveniences of intravenous therapy and of the varied conditions of absorption like pH changes, presence of enzymes, gastric emptying time are other advantages of topical preparations.[2] Topically applied dermal and transdermal delivery systems could replace needles required to administer many of the new biologics-based drugs and vaccines, in addition to other significant advantages such as avoiding first-pass hepatic metabolism, gastric degradation and frequent dosing. However, the limited dermal and transdermal delivery of many small and large molecules is a significant challenge because of the unyielding barrier properties of the skin.[3]

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.[4]

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.[5]

CLASSIFICATION OF TOPICAL DRUG DELIVERY SYSTEMS[6]

A. **Solid:** Powders, Plasters Ointments,
B. **Semi solid:** Creams, Poultices, Gels, Pastes
C. **Liquid:** Liniment, Lotions, solution, tinctures, Emulsions, Suspensions, Paints
D. **Miscellaneous:** Transdermal drug delivery systems, Tapes and Gauzes, Rubbing alcohols, Liquid cleanser, and Topical aerosol.

RATIONAL

Rational Topical dosage forms like cream, lotion, ointment have many disadvantages. Some of which are greasiness and stickiness, causing problems to patients in application and having low spreading coefficient and requirement of rubbing are also considered as disadvantages. Also may causes stability problem of hydrophilic drug formulation. Due to these shortcomings with the semisolid group of preparations, the use of gellified formulation has been expanded both in pharmaceutical preparations and in cosmetics. Gel is colloidal preparation containing 99 % part of liquid where macromolecular network of fibres built from a gelling agent and liquids are immobilized by surface tension between them. In spite of advantages a major problem is to delivery of hydrophobic natured drugs. Emulsion based strategies can be used to incorporate lipophilic therapeutic moiety in gel built system to overcome this problem.[7]

EMULGEL

Emulgel is evolving field for the topical drug delivery, and up to the date it has less marketed product, so it is thought-provoking and challenging to focus on emulgel formulation. Dispersed (internal phase) into other (external phase), with the use of emulsifying agent to make system stable. Emulsions are of oil-in-water or water-in-oil type, in which the drug particle entrapped in internal phase passes through the external phase and then slowly gets absorbed into the skin to deliver controlled effect. USP defines gel is a semisolid system comprises dispersions of either small inorganic particles or large organic molecules enfolding and interpenetrated by liquid. The gel contains the larger amount of aqueous or hydro alcoholic liquid entrapped in a network of colloidal solid particles where it entangled small drug particles and maintain the controlled release of drug. The liquid phase form a three-dimensional polymeric matrix like structure which results a physical or chemical cross-linking network. The continuous structure which behaves like solid that are homogenous and clear. The emulsion and gel both are liable for the controlled drug release from the systems.[8-10]

There are two types of gels first the organic solvent based also known as hydrophobic or organogels and second the water based also known as hydrophilic or hydrogels. First one consist of liquid paraffin with polyethylene or fatty oils gelled with colloidal silica, aluminium or zinc soaps along with base and the second one consist of base of water, glycerol, or propylene glycol.[11,12] Gels having many advantages has still restrictions in the delivery of hydrophobic drugs so to overcome this and enjoy the delivery in the form of gel for the hydrophobic drug, the theory for emulgel was introduced where the hydrophobic drugs are merged in emulsion and then to gel.[13] Emulgel is the approach using the aids of both emulsion and gels, gaining the twofold controlled release effect where the emulsion either oil in water or water in oil is gelled by incorporation in the gel base.[14]

Emulgel are seen better choice for the class II of drug as per the BCS classification systems that show poor solubility and high permeability.[15] Emulgel possess the properties as thixotropic, greaseless, water soluble, easily spreadable, nonstaining, easily removable, emollient, long shelf life, bio- friendly and attractive appearance that increases the patient acceptability.[16]

TYPES OF EMULGELS[17]

1. Macroemulsions gel

These are most common type of emulgels where the particle size of droplets of emulsion is more than400nm. They are visually opaque but the individual droplets can be easily observed under microscope. Macroemulsion are thermodynamically unstable, but can be stabilized using surface active agents. e.g. Mefenamic acid emulgel is prepared using Carbopol 940 as gelling agent. Liquid paraffin is used as oil phase. Mentha oil and clove oil is used as penetration enhancer. Then it is evaluated for rheological studies, spreading coefficient studies, skin irritation test, in-vitro release, etc.

2. Nanoemulgel

When nanoemulsion is incorporated into gel it is called as nanoemulgel. Nanoemulsions are thermodynamically stable transparent (translucent) dispersions of oil and water stabilized by an interfacial film of surfactant and co surfactant molecules having a droplet size of less than 100 nm. Nanoemulsion formulations possess improved transdermal and dermal delivery properties in vitro as well as in vivo. Nanoemulsions have improved transdermal permeation of many drugs over the conventional topical formulations such as emulsions and gels. Carvedilol nanoemulgel is prepared using oleic acid and isopropyl myristate (3:1) as oil phase. Tween 20 and Carbitol are used as surfactant and co surfactant respectively. Carbopol 934 is used as gelling agent.

3. Microemulsion

Microemulsions are transparent and thermodynamically stable as their droplet size range from 10 to 100 nm and they do not coalesce. Microemulsions are composed of

oil, surfactant, co surfactant and water in specific proportions. The ingredients of microemulsion could facilitate the permeation rate of the drug by reducing the diffusion barrier of the stratum corneum. However, due to low viscosity of microemulsion, their less retention capacity in the skin restrains its application in the pharmaceutical industry. To overcome this disadvantage, gelling agents such as Carbopol 940, xanthan gum and carrageenan have been added into the microemulsion for forming microemulsion based gel in order to increase its viscosity whichcould be suitable for topical application. Moreover, microemulsion based gel prevents the absorption of drug in the blood stream and provide higher drug accumulation in the skin for efficient action. Clotrimazole microemulsion based vaginalgel is prepared using Capryol 90 as oil phase and Cremophor EL as surfactant. Carbopol ETD 2020 is used as gelling agent.

ADVANTAGES OF EMULGEL[18-20]

1. Improved patient acceptability.
2. Offer targeted drug delivery.
3. Termination of the therapy at any time.
4. Enhance bioavailability as well as the low doses can be effective in comparison with other conventional semi solid preparation.
5. Became a stable formulation by decreasing surface interfacial tension which leads to increase the viscosity of aqueous phase, more stable as compare to transdermal preparations which are comparatively less stable.
6. Hydrophobic drug can be easily incorporated in emulgel form by using emulsion as the drug barrier which is finally dispersed in to gel.
7. Provide the controlled effect of that helps to prolong the effect of drug with short half-life.
8. Easy to formulate and cost effective preparation.
9. Drug loading capacity is better than other novel dosage forms like niosomes and liposomes
10. Skin penetration is enhanced due to both hydrophilic and hydrophobic nature.

DISADVANTAGES[15, 21]

1. Create problem in absorption of macromolecules.
2. Entrapment of air bubble during formulation.
3. Only hydrophobic drugs are the best choice for such delivery systems.

PHYSIOLOGY OF SKIN[22]

The skin is an extensive and legitimate focus for drug delivery. Its fundamental capacities constrain its utility for this region. Skin is the largest organ of the body which making up 16% of the body weight, with a surface area of 1.8m^2. Apocrine gland, sweat gland, hair, nails, oil gland are referred as derivatives of skin. The elements of the skin are predominantly to shield the body from the unwanted substances and microorganisms and to contain all body liquids**.**

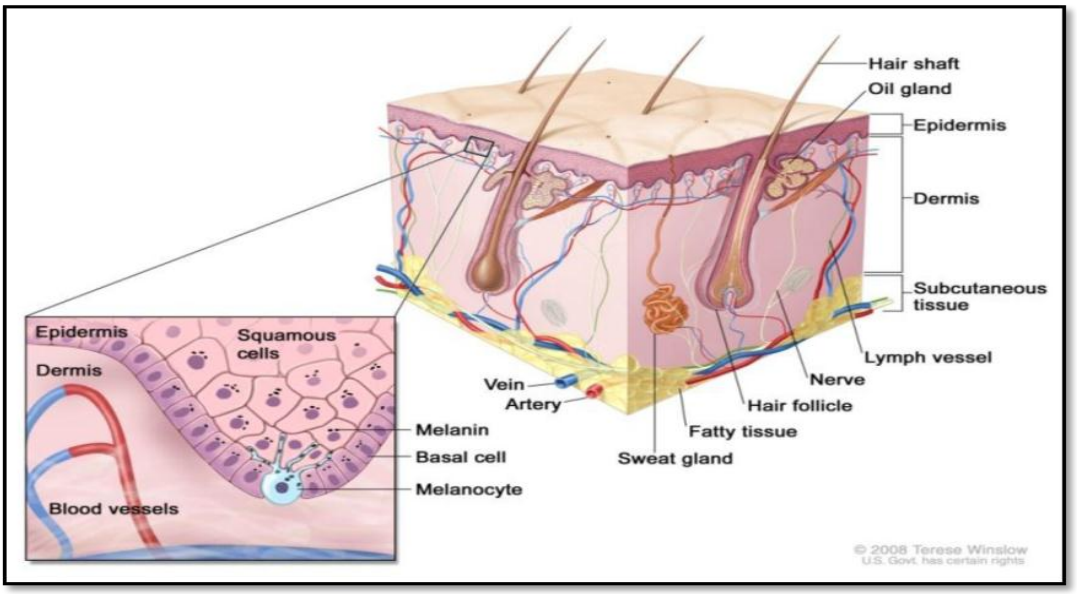

Figure 1: Structure of skin.

Skin layers: Skin contains three structural layers – Epidermis, dermis and Hypodermis.

a) Epidermis

The epidermis is a squamous, stratified, keratinized epithelium. The keratinocyte contain the major cell segment greater than 90%. Keratinocytes alter their shape, size and physical properties when relocating to the skin surface. Stratum corneum is approximately 100 – 150 mm thick, has no blood stream. Stratum corneum is the peripheral layer of epidermis. Under the epidermis, the dermis contains the arrangement of vessels that vehicle blood all through the body. On the off chance that the drug has the capacity infiltrate the stratum corneum, then it can enter the circulatory system. A procedure known as passive diffusion, which happens to gradually, is the only means to transfer normal drug

across the layer. Epidermis is also containing melanocytes, Langerhans cells and Merkel cells.

b) Dermis

The dermis is the internal layer and bigger (90%) skin layer, involves basically of connective tissue and gives backings to the epidermis layer of the skin. The dermis can be partitioned into two anatomical district, papillary dermis and reticular dermis. Papillary is the more slender peripheral segment of the dermis. Collagen and elastin filaments are basically vertically situated in the papillary locale and associated with the dermal-epidermal intersection. In reticular dermis, strands are on a level plane arranged. As skin is central point for the determination of different medication conveyance angles like permeation and absorption of drug over the dermis.

c) Hypodermis

The hypodermis is the fat tissue layer which is found in the middle of dermis and aponeurosis and fasciae of the muscles. The subcutaneous fat tissue is basically and practically is very much coordinated with the dermis through the nerve and vascular systems. The hypodermis layer is made out of free connective tissues and its thickness differs as indicated by the surface of body.

ESSENTIAL CONSTITUENTS OF EMULGEL PREPARATION

❖ **Aqueous Material**

This forms the aqueous phase of the emulsion. Normally used agents are water, alcohols.

❖ **Oils**

These agents form the oily phase if the emulsion. For externally applied emulsions, mineral oils, either alone or combined with soft or hard paraffins, are broadly used both as the vehicle for the drug and for their occlusive and sensory characteristics. Generally 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.

❖ **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.eg Polyethylene glycol stearate, Sorbitan mono- oleate (Span 80), Polyoxyethylene sorbitan monooleate (Tween 80), Stearic acid, Sodium stearate.

❖ **Gelling Agent**

These are the agents used to increase the consistency of any dosage form can also be used as thickening agent.

❖ **Permeation Enhancers**

These are agents that partition into and interact with skin constituents to induce a temporary and reversible increase in skin permeability.

FORMULATION OF EMULGEL[23, 24]

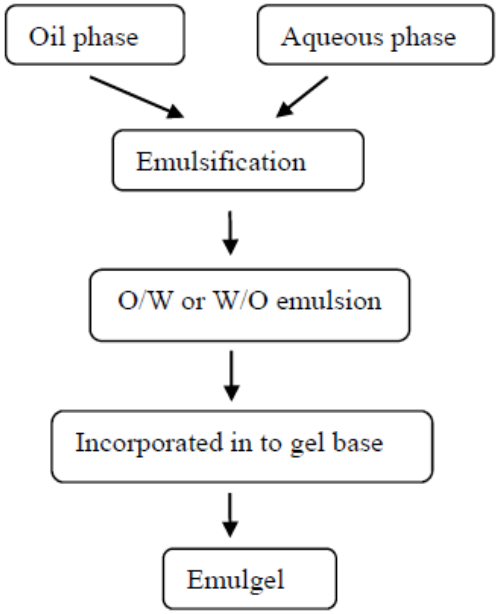

Figure 2: Method of preparation of Emulgel.

A. Formulation of gel base

The gel stage is set up by dissolving the polymer in the separated water with enduring mixing at moderate pace using mechanical shaker and the pH was adjusted to 6-6.5 using triethanolamine.

B. Formulation of emulsion

Depending upon whether oil in water or water in oil emulsion was formulated. Oil phase of the emulsion was set up by dissolving emulsifier e.g. cross 20 in oil vehicle like liquid paraffin while the watery stage is set up by dissolving hydrophilic emulsifier like tween 20 in refined water. Added substances like methyl paraben and propyl paraben are separated in humectant like propylene glycol. The medicine was separated in watery dissolvable like ethanol. Both the plans of solution and added substances are mixed with watery stage with consistent blending. Both the smooth and liquid stage were freely warmed to 70°C then the smooth stage was added to watery stage with constant blending. This mix was cooled to room temperature to shape an emulsion.

C. Incorporation of the emulsion into gel base

Finally emulsion was incorporated in gel base to form emulgel.

EVALUATION OF EMULGEL[25]

1. Physical examination

The prepared emulgel formulations were inspected visually for their color, appearance, consistency, grittiness, phase separation and homogeneity.

2. Rheological measurements

The rheological properties of emulgel samples are determined using cone and plate Brookfield viscometer. About 0.5 g of the formula to be tested is applied to the plate and left for equilibrium, measurements are made at 20°C and at shear rates ranging from 0.4 to 400 s−1 corresponding to 0.2 to 200 rpm with 10 s between each two successive speeds and then in a descending order. The hysteresis loop between the upward and downward curve is studied. The flow index is determined by linear regression of the logarithmic form:

$$\sigma = k\gamma^n$$

Where σ is the shear stress, γ is the shear rate, k is the consistency index, and n is the flow index. $n = 1$ when the flow is Newtonian, if $n > 1$ or $n < 1$ indicates shear thickening or shear thinning respectively. Also the apparent viscosity at 20 s−1 is determined from the rheograms.

3. In vitro permeation studies

Release experiments employed the FDC-6 Transdermal Diffusion Cell Drive Console.The system is fitted with VTC-200 heater circulator with jacketed vertical glass Franz diffusion cells being the main unit. The artificial membrane is mounted between the donor and receptor compartments of the diffusion cells. These cells provided a diffusional area of 1.7 cm2, and the receptor compartment is 12 ml. The tested formulations (about 1 g) are loaded into the donor compartment before occluding the donor compartments using a parafilm. To maintain sink conditions, 30% (*v*/*v*) ethanol in phosphate buffer solution (PBS; pH 7.4) is used as a receptor. The system is maintained at 37 ± 0.5°C by a water bath circulator and a jacket surrounding the cell, resulting in a membrane-surface temperature of 32°C to mimic skin permeation experimental conditions. Receptor samples, 5 mL are taken periodically, and the cells are replenished up to their marked volumes with fresh receptor. Addition of the receptor to the receiver compartment is performed with great care to avoid trapping air beneath the cellulose membrane.These samples are analyzed for the drug content by HPLC. The cumulative amount of drug released is calculated as a function of time. Each experiment is performed at least three times, and the results are averaged (variation coefficient (CV) <5%).

4. Skin Irritation Study

The skin irritation test is carried out on male Wistar albino rats weighing 200 to 225 g. Theanimals are kept under standard laboratory conditions, with temperature of 25 ± 1°C and relative humidity of 55 ± 5%. The animals are housed in polypropylene cages, six per cage, with free access to standard laboratory diet and water *adli. bitum*. The hair on the dorsal side of the rats is removed with an electric hair clipper on the previous day of the,experiment. The rats are divided into three groups ($n = 6$). Group I served as control, without any treatment. Group II receives topical 100-mg selected emulgel formulation and group III receives 0.8% *v*/*v* aqueous solution of formalin as a standard irritant. The animals are applied with new NAP gel, or new formalin solution, each day up to 6 days. Finally, the application sites are graded according to a visual scoring scale, always by the same investigator. The mean erythemal scores are recorded depending on the degree of erythema.

5. In vitro drug release study

Franz diffusion cell (with effective diffusion area 3.14cm² and 15.5ml cell volume) is used for the drug release studies. Emulgel (200mg) is applied on to the surface of egg membrane .The egg membrane is clamped between donor and receptor chamber of diffusion cell. The receptor chamber is filled with freshly prepared PBS (pH 5.5) solution to solubilize the drug. The receptor chamber is stirred by magnetic stirrer. The samples (1.01ml aliquots) are collected at suitable time interval sample are analyzed for drug content by UV visible spectrophotometer at 271 nm after appropriate dilutions. Cumulative corrections are made to obtain the total amount of drug release at each time interval. The cumulative amount of drug release across the egg membrane is determined as a function of time.

6. Measurement of pH

The pH of Emulgel formulations is determined by using digital pH meter. One gram of gel is dissolved in 100 ml of distilled water and it is placed for two hours. The measurement of pH of each formulation is done in triplicate and average values are calculated.

7. Viscosity measurement

The viscosity of KT formulations is determined using Brookfield DV-III at temperature 25°C. Fifty grams of the sample is tested using a 50 ml capacity vessel using spindle 94 at speed 20 rpm.

8. Stability studies

All of the formulations are subjected to stability testing at different temperature conditions (4°C and room temperature, 25°C) for 3 months.

9. Ex vivo skin permeati3on studies

The topical microemulsion gels are evaluated for *ex vivo* skin permeation profile. The *ex vivo* skin permeation study is done on developed NDFX-MEG as well as on commercial formulations to compare the permeation rate of NDFX from respective formulation. The *ex vivo* permeation studies are performed with Franz diffusion cell at 37° under magnetic stirring using abdominal skin of male wistar rat. The skin samples are hydrated in phosphate buffer pH 6.8 for 1 h before use.

10. Gel Spreadability

The spreadability is represented by the thickness of the film that the preparation leaves on the skin. Those producing thinner films, with higher spreadability, are naturally of greater interest. A sample of 0.4 g of each formula is pressed between two slides (divided into squares of 5-mm sides) on which weights of 50, 100, 200, and 500 g are placed at intervals of 1 min. The

diameters during each interval are given as the area (square centimeter). The variations of the area as a function of weight are then analyzed as response factors. The sample weight is fixed in order to perform the entire assay with all the samples, without surpassing the limits imposed by the glass, avoiding sliding and easily differentiating the behavior of different samples. The results obtained are average of three determinations.

11. Drug Content Determination

The drug content in emulgel is measured by dissolving known quantity of emulgel formulation in methanol by sonication. Absorbance is measured after suitable dilution at 277 nm using UV-Visible spectrophotometer.

12. Swelling Index

Swelling index of prepared topical emulgel is determined by taking 1gm of gel on porous aluminium foil and then placed separately in a 50ml beaker containing 10ml 0.1N NaoH. Then samples are removed from beakers at different time intervals and put it on dry place for sometime after it reweighed. Swelling index is calculated as follows:

Swelling Index (SW) %= [(Wt-Wo)/Wo] x100.

Where, (SW) % = Equilibrium percent swelling,

Wt = Weight of swollen emulgel after time t,

Wo = Original weight of emulgel at zero time.

NON-STEROIDAL ANTI-INFLAMMATORY DRUGS (NSAIDs)[26]

The non-steroidal anti-inflammatory drugs (NSAIDs) are widely used for the treatment of minor pain and for the management of edema and tissue damage resulting from inflammatory joint disease (arthritis). The amounts of these drugs are have antipyretic activity in addition to having analgesic and anti-inflammatory actions, and thus have effectiveness in the treatment of fever. Most of these drugs express their therapeutic actions by inhibition of prostaglandin biosynthesis as described in the units that follow. Some of the primary suggestions for NSAID therapy including the Rheumatoid Arthritis (RA), Osteoarthritis (OA), Acute gouty arthritis and Dysmenorrheal.

NSAID MECHANISM OF ACTION

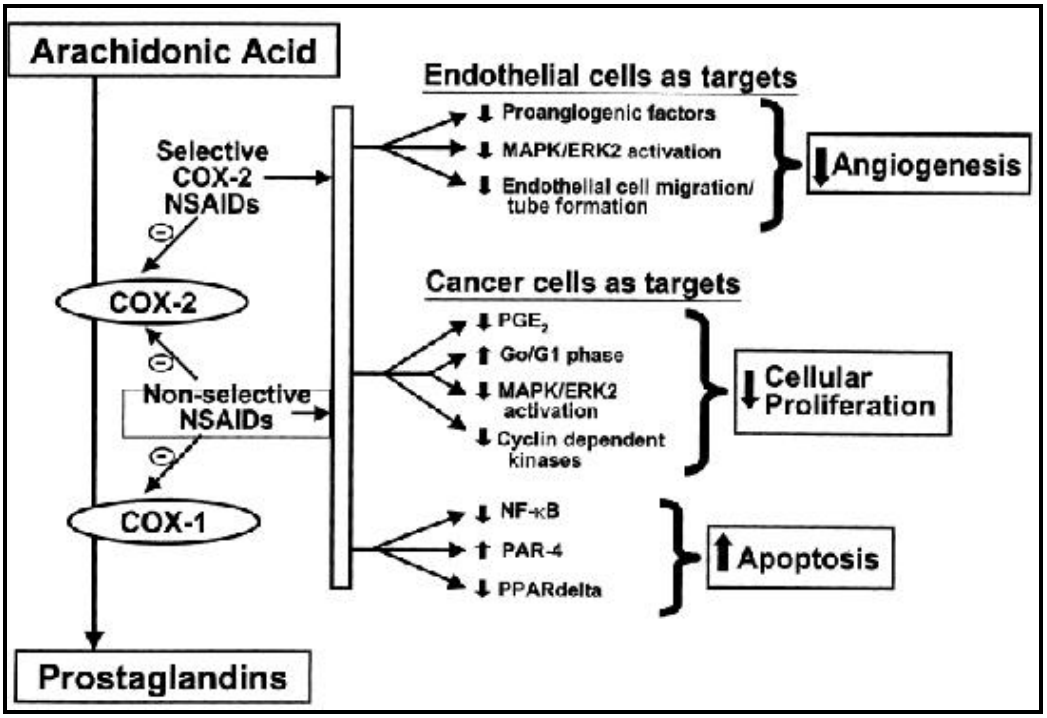

Figure 3: Mechanism of NSAIDs Drugs.

The main mechanism of NSAIDs and its therapeutic actions (antipyretic, analgesic, and anti- inflammatory activities) are inhibition of prostaglandin (PG) production. Particularly NSAIDs competitively inhibits cyclooxygenases (COXs), the enzymes that catalyze the formation of cyclic end peroxides from arachidonic acid to form prostaglandins. Two COX iso-enzymes are identified, COX-1 and COX-2. COX-1, expressed constitutively, is synthesized continuously and is existent in all tissues and cell types, most particularly in platelets, endothelial cells, the GI tract, renal microvasculature, glomerulus, and collecting ducts. Thus COX-1 is significant for the production of prostaglandins of homeostatic maintenance, such as platelet aggregation, the instruction of blood flow in the kidney and stomach, and the regulation of gastric acid secretion. Inhibition of COX-1 activity is considered a main donor to NSAID GI toxicity. COX-2 is considered an inducible isoenzyme, though there is some constitutive expression in the kidney, brain, bone, female reproductive system, neoplasias, and GI tract. The COX-2 isoenzyme acts an important role in pain and inflammatory processes.

Commonly, the NSAIDs inhibit both COX-1 and COX-2. Most NSAIDs are mainly COX-1 selective (eg, aspirin, ketoprofen, indomethacin, piroxicam, sulindac). Others are considered slightly selective for COX-1 (eg, ibuprofen, naproxen, diclofenac) and others may be considered slightly selective for COX-2 (eg, etodolac, nabumetone, and meloxicam). The mechanism of action of celecoxib and rofecoxib is mainly selective inhibition of COX-2; at therapeutic concentrations, the COX-1 isoenzyme is not inhibited therefore GI toxicity may be reduced. Other mechanisms that may contribute to NSAID anti-inflammatory actions includes the reduction of superoxide radicals, stimulation of apoptosis, inhibition of adhesion molecule expression, reduction of nitric oxide synthase, decreases the pro-inflammatory cytokine levels, alteration of lymphocyte activity, and modification of cellular membrane functions.

MARKETED EMULGEL FORMULATIONS FOR NSAIDs DRUGS

The some of the NSAIDs are available in the market. Some of the marketed products are given in the table.1.

Table 1: Marketed Emulgel Formulations for NSAIDs

Sr.NO	PRODUCT	CONTENT	MANUFACTURER
1	Coolnac Gel emulgel	Diclofenac diethylamine	Community Pharmacy Public Co Ltd
2	Voltaren Emulgel	Diclofenac diethylamine	Novartis Pharma
3	Isofen Emulgel	Ibuprofen	Beitjala Pharma
4	Voltarol Emulgel P	Diclofenac diethylamine and diclofenac sodium	GlaxoSmith Kline Pharma
5	Volini GEL	Diclofenacdiethylamine	Ranbaxy Laboratories

Figure 4: Marketed Emulgel Formulations.

CURRENT RESEARCH IN FORMULATION OF EMULGEL FOR NSAIDs

Some of the emulgel formulations of the NSAIDs are formulated by the researchers. The formulations are the mainly can be contains the oil phase and aqueous phase and the polymers. The oil phase and the liquid phase are the used for the formulation by the using of emulsifiers, and the polymers used in the emulgel preparations are the gelling agents, which is used for the thickening of the medium and emulgel formation. The oil phase, aqueous phase and polymer used in the formulation of emulgels by the researchers are given in the table.2.

Table 2: Current Research on NSAIDs Emulgel

Sr. No	Active Pharmaceutical Ingredient	Oil Phase	Aqueous Phase	Polymers	Researchers
1	Piroxicam	Liquid paraffin	Purified water	Methyl cellulose, Polyethylene glycol	Kumar B Lathiyar e*et al.*
2	Meloxicam	Castoroil, sunflower oil, olive oil and**o**leic acid	Water	Carbopol981N Carbopol 974NF	Arti Pednekar *et al.*
3	Ketoprofen	Liquid paraffin	Purified water	HPMC, HPC	Khaled M Hosny *et al.* M
4	Naproxen	Light liquid paraffin,	Purified water	Carbopol-934, HPMC, Pluronic F127	Shokri *et al.*
5	Mefenamic acid	Liquid paraffin peppermint oil	Purified water	Carbopol940	Khalid W *et al.*
6	Aceclofenac	Liquid Paraffin	purified water	carbopol 934 carbopol 940 carbopol 980	Archana GL *et al.*

CONCLUSION

Emulgel is a modern tool for topical delivery of hydrophobic drugs with advantages of emulsion and gel to improve patient acceptability. Mainly the hydrophobic drug formulation can be developed using emulgel technique because it contain both oil and aqueous phase while hydrogels are not suitable for hydrophobic drugs. In future, topical drug delivery will be used extensively to impart better patient compliance. Emulgel helps in enhancing spread ability, adhesion, viscosity, and extrusion. It is used both pharmaceutical and cosmetical applications as well as it allow to incorporate herbal formulations. Emulgels are the formulated by mixing of emulsion with the gelling agents (polymers). The NSAIDs drugs are the having the advantages of administration of topical route in the form of Emulgel. In this review concluded that the emulgel formulations are the more advanced formulations used for the NSAIDs drug.

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