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EMULGELS FOR TOPICAL DRUG DELIVERY: A REVIEW ON CURRENT TRENDS, CHALLENGES AND FUTURE PROSPECTS

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ABSTRACT :

Topical drug delivery has emerged as an alternative to parenteral and oral routes, particularly in the context of reducing systemic adverse effects and obtaining localized therapeutic benefit. Because of their combinatorial properties of emulsions and gels including improved solubility, stability, patient compliance, and controlled drug release, the emulgels have become the focus of interest as a new carrier system. Natural polymers, nanotechnology-based methodologies and multi-potent excipients, which are useful for permeation and therapeutic activity, are the other recent novel concepts for emulgel formulations emerged through the literature review. It also considers the main challenges which must be addressed for emulgels to be widely commercialised – including obstacles to skin penetration, product stability, scale-up, regulation and patient acceptability. Future prospects are also emphasized, as developments in biocompatible polymers, stimuli-responsive materials and personalized medications are expected to revolutionise the future of topical therapy with emulgels. Emulgels have long been considered as the promising novel delivery systems for topical application due to the merging of both pharmaceutical formulation and advanced materials science.

KEWWORDS: New drug delivery technologies, permeation enhancement, topical drug delivery, emulgel, formulation issues, future prospects

INTRODUCTION

Topical medication delivery methods have been long established for many years to cure various skin conditions and cause the effect occurring straight under the application site. Compared to exploral and parenteral means of administration, a topic has certain advantages of not having first-pass metabolism, causing minimal systemic side effects, and contributing to patients' better adherence. However, most of the traditional topics, such as lotions, creams, and ointments, are characterized to feature low patient acceptance, oily nature, poor drug penetration, and persistence. Emulgels, incorporating properties of both gels and emulsions, represent one such novel drug delivery technology. Hydrophilic as well as lipophylic medications can be incorporated due to the emulsion part and the gel base introduces thixotropy, enhanced consistency, spreadability and patient compliance. This unique combination provides the controlled and sustained release of therapeutic agents, enhanced penetration of actives to the skin and drug solubility. Emulgels have increasingly been studied in the past for the delivery of various drugs such as analgesics, antifungals, anti-inflammatories, and cosmetics. Their applications in current pharmaceutics have been extended by incorporating penetration enhancers, natural and synthetic polymers and modifications derived from nanotechnology. Even with these advances, emulgels continue to face the challenges of stability, and up scale production and regulatory approval in commerce due to which they are not being used commercially in commerce. Emulgels have been extensively investigated during recent years for the drug delivery of numerous drugs such as analgesics, anti-fungals, anti-inflammatory agents and cosmetics. They have become more attractive in the modern pharmaceutics with the addition of penetration enhancers, natural and synthetic polymers, modifications based on nanotechnology, protocol etc. Despite these advances, emulgels still face several barriers (e.g., stability, scalability and regulatory approval) that have limited its industrial use. [(1)(4)]

EMULGELS: COMPONENTS AND STRUCTURE:

STRUCTURE:

By incorporating an emulsion (oil-in-water or water-in-oil) into a gel matrix a biphasic system or an emulgel is formed.

Continuous phase (GEL MATRIX): Provides stability, and viscosity as well as controlled release.

Dispersed Phase: Lipophilic and/or hydrophilic drugs can be present in the disperse phase (emulsion droplets).

3D network: Maintains rheology and structural integrity.

Three-dimensional network: Preserves rheology and structure. [(2)(6)]

IMPORTANT COMPONENTS:

Oily phase: Natural oils, isopropyl myristate, and liquid paraffin.

Water phase: propylene glycol, glycerine, purified water.

Emulsifiers: Lecithin, Span 20, Tween 80.

Examples of co-surfactants: PEG, ethanol and propylene glycol.

Cross-linking agents: sodium alginate, HPMC and carbopol 934/940.

Penetration promoters: DMSO, OA, and Ment

Antimicrobials: Propyl and methyl paraben

pH buffer: triethanolamine (TEA).

Active drug: could be either lipophilic or hydrophilic depending upon the purpose of therapy. [4]

MECHANISM OF TOPICAL DRUG DELIVERY VIA EMULGELS:

Spread and Apply: Gel type base applies smoothly and ensures an even application.

Drug release: The drug is released from oil droplets (lipophilic) or the aqueous phase (hydrophilic).

Penetration to Skin: Penetration enhancers disrupt the stratum corneum lipid bilayer.

Disposition: Acts both locally and systemically through the dermis and epidermis.

Therapeutic Response: There may be a systemic–e.g., anti-inflammatory) or local–e.g., local anaesthetic effect. [3][5]

FORMULATION STRATEGIES AND EVALUATION PARAMETERS:

FORMULATION STRATEGIES:

Oil and aqueous phase preparation.

Emulsifying agents or co-emulsifying agents are employed in the formation of emulsions.

Gel base preparation with HPMC or Carbopol.

Emulsion was added to gel base with constant stirring. [6]

EVALUATION PARAMETERS:

Physical examination: pH, homogeneity, and visual.
Rheology: Spreadability and viscosity.
The mechanical properties: include swelling index and extrudability.
Uniformity of drug content: spectrophotometry/chromatography.
In vitro release studies: using Franz diffusion cell.
Both animal and human skins are used in ex-vivo and in-vivo studies.
Microbial Testing: In antimicrobial preparations.
Irritations tests: Skin compatibility and safety are checked. [4][6]

RECENT ADVANCES AND APPLICATIONS:

RECENT ADVANCES:

Nano-emulgels: efficient penetration, solubility and sustained release.

Herbal based emulgels: In emulgels plant-based components such as Aloe vera, Curcumin and plant essential oils are used.

Stimuli-responsive emulgels release: pH, temperature, and enzymes may trigger the stimuli-responsive emulgels release.

Double-action formulations: (i.e., antibacterial and anti-inflammatory agents) are obtained with the combination of antibacterial and anti-inflammatory drugs.

Biopolymers: Chitosan and xanthan gum are some of the biopolymer-based formulations developed as emulgels for eco-friendly systems. [3][5]

APPLICATIONS:

Fungal infections, psoriasis, eczema, and acne are among our dermatological treatments.

Analgesic and anti-inflammatory drugs delivery: Piroxicam, ibuprofen and diclofenac.

Antimicrobial/antifungal therapy (e.g., mupirocin, clotrimazole, terbinafine) is an example.

Whitening agents, moisturisers, sunscreens and anti-ageing creams are recognised as cosmeceuticals.

Herbal containing emulgels for wound healing.

Systemic/hormonal therapy: cardiovascular drugs, estrogens, and androgens. [3][5]

CHALLENGES AND LIMITATIONS

Formulation issues: are respectively phase separation, excipient incompatibility, and pH sensitivity.

Barrier: Varying degrees of permeability from one person to the next.

Manufacturing Problems: There are also manufacturing concerns such as droplet size dispersion and scale-up

Patient-related problems: are the poor drug loading, cosmetic acceptance, and skin irritation.

Regulatory barriers: include high development costs and the absence of standardised process. [4][7]

FUTURE PROSPECTS:

Nanotechnology integration: Nano-emulgels to enhance delivery.

Smart emulgels: Targeted and stimuli responsive release.

Personalised medicine: 3D printed personalised emulgels.

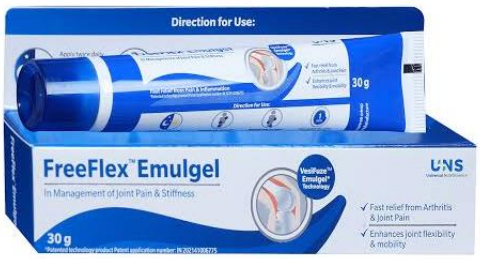
Biopolymer/herbal systems: less hazardous and eco-friendly systems.

Combination therapy: is multiple medications given to manage chronic conditions.

Systemic uses: include hormonal therapy, cardiovascular disease and dermatitis.

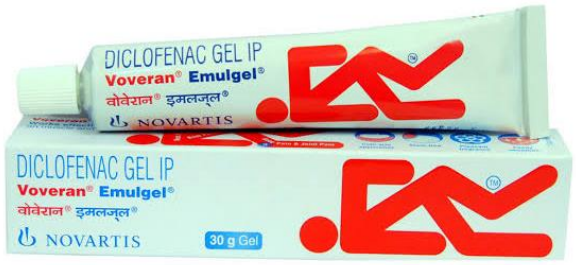
Regulatory evaluation: It is a part of the regulatory development when they create normalized rules which will enable commercialization. [3][4]

MARKETED FORMULATIONS:



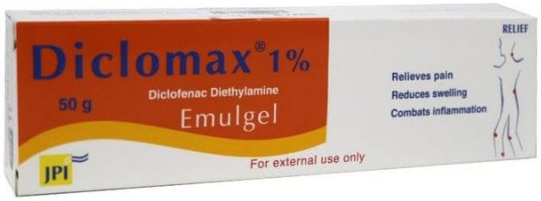
Joint Pain and stiffness emulgel

Fig no:01



Diclofenac emulgel

Fig no:02



Diclofenac diethylamine emulgel

Fig no:03

Skin lightening emulgel

Fig no:04

Inflammation reduces emulgel

Fig no:05

CONCLUSION:

Hybrids between gels and emulsions (i.e., emulgels) are a completely novel type of drug delivery system and excels the advantages of gels and emulsions. They are suitable for topical and transdermal delivery due to better solubility of drugs, stability, release control as well as for improved patient compliance. The discipline is emerging rapidly due to recent progress in nanotechnology, stimuli-responsive technologies, and herbal formulations, although there are obstacles in terms of formulation stability, high-volume production, and regulatory acceptance. Emulgels can further be developed to be a next generation drug delivery system to formulate safe, efficacious, and patient acceptable therapeutic treatments with further study and regulatory support.

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