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Review Article

Minoxidil Emulgel for Androgenic Alopecia: A Literature Review Including Patents

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Abstract

Minoxidil is a powerful vasodialator (antihypertensive drug), i.e. direct relaxation of arteriolar smooth muscle with little effect on venous capacitance. Minoxidil is the only FDA approved topical medication with proven efficacy for the treatment of androgenic alopecia. Alopecia is characterized by round or oval patches of non-scarring hair loss. It is believed that it only causes scalp hair loss that may be partial (transient or persistent) or complete (alopecia totalis), but sometimes it may progress to cause total body hair loss (alopecia universalis). Eumlgels are emulsion gels which contains randomly distributed oil microdroplets. They are emulsions either of oil-in- water or water-in-oil type, which are gelled by mixing with gelling agent. Emulgels have been found to be novel approach for the treatment of various topical disorders. According to the various literature collected emulgels were found to be optimum over other topical preparations i.e. gel, cream, etc.

Key words: Minoxidil, Androgenic alopecia, Emulgel, Patents, Polymers.

INTRODUCTION

Loss of hair or alopecia is one of the most common problems of many societies causing considerable economical and physiological consequences. Alopecia generally pertains to the loss of hair on the scalp, although other body sites may be affected. (27)

Alopecia areata and androgenic alopecia (male pattern baldness) are two common types of alopecia. Alopecia areata is characterized by round or oval patches of non-scarring hair loss. It is believed that it only causes scalp hair loss that may be partial (transient or persistent) or complete (alopecia totalis), but sometimes it may progress to cause total body hair loss (alopecia universalis). (24).

There are many treatments available for regrowth of the hair of which, only two treatment shave FDA approved indication for the treatment of AGA: minoxidil and finasteride. Minoxidil is the only FDA approved topical medication with proven efficacy for the treatment of AGA. Although the mechanism of action of minoxidil is unknown, it may increase the blood supply to the scalp allowing more oxygen, blood, and nutrients to the follicle which may lengthen the anagen phase by proliferative and anti apoptotic effects on dermal papilla cells of the hair follicles. (27)

TOPICAL DRUG DELIVERY SYSTEM

Transdermal drug delivery system provides a means to sustain drug release as well as reduce the intensity of action and thus reduce the side effects associated with its oral therapy. Transdermal drugs are self-contained, discrete dosage form. Drugs can be delivered across the skin to have an effect on the tissue adjacent to the site of application (topical delivery) or to have an effect after distribution through the circulatory system (systemic delivery). Bypassing the gastrointestinal tract would obviate the GI irritation that frequently occurs and avoid partial first pass activation by the liver. The transdermal route is indeed desirable, but there is one small obstacle: whereas the function is to keep things out of the body. The major barrier within the skin is stratum corneum, the top layer often called epidermis. Thus, transdermal absorption occurs through a slow process of diffusion driven by the gradient between the high concentration in the delivery system and the zero concentration prevail-

ing the skin, delivery system must be kept in continuous contact with the skin for a considerable time i.e. hours to days. (2)

To minimize the side effects and to improve therapeutic efficiency the new formulations of minoxidil in the form of emulgel is used for the treatment of the hair loss. Compared to the other topical dosage forms, emulgel may provide unique properties and advantages. (27)

EMULGEL

Gels are currently receiving increasing attention, especially hydrogel formulations, for topical application of drugs since they have an attractive appearance and develop pleasant cool feeling. Eumlgels are emulsion gels which are hydrogels containing randomly distributed oil microdroplets. They are emulsions either of oil-in- water or water-in-oil type, which are gelled by mixing with gelling agent. They have been recently used as vehicles to deliver various drugs to the skin, vagina, etc. Emulgels have been used to overcome the unwanted effects caused by drug substances making the formulation more tolerable. Different vegetable oils with emollient properties have been used as oil phase to alleviate the considerable skin dryness and irritation caused by drug, which sometimes leads to the discontinuation of the treatment.

Advantages of Emulgel

- Incorporation of hydrophobic drugs.
- Better loading capacity.
- Better stability.
- Production feasibility and low preparation cost.
- Controlled release.
- No intensive sonication. (13)
- Avoidance of first pass metabolism.
- Avoidance of gastrointestinal incompatibility.
- More selective to a specific site.
- Improve patient compliance and suitability for self medication.
- Providing utilization of drug with short biological half life and narrow therapeutic window.
- Ability to easily terminate medication when needed. (23)

Disadvantages of Emulgel

- Skin irritation of contact dermatitis may occur due to the drug and/or excipients.
- Poor permeability of some drugs through the skin.
- Possibility of allergenic reactions.
- Drugs of larger particle size not easy to absorb through the skin. (23)
- Enzyme in epidermis may denature the drugs. (20)

ANTIHYPERTENSIVE DRUGS

Antihypertensive drugs are the drugs used to lower BP in hypertension. Hypertension is a very common disorder. It is not a disease in itself, but is an important risk factor for cardiovascular mortality and morbidity. Hypertension should be that level of BP at or above which long term antihypertensive treatment will reduce cardiovascular mortality. The JNC 7* and WHO-ISH guidelines 2003 have defined it to be 140mm Hg systolic and 90mm Hg diastolic, through risk appears to increase even above 120/80 mm Hg. Epidemiological studies have confirmed that higher the pressure (systolic or diastolic or both) greater is the risk of cardiovascular disease.

MINOXIDIL AS VASODIALOTORS

Chemically minoxidil is 2,4-pyrimidinediamine, 6-(1-piperidinyl)-, 3-oxide with chemical formulae $C_9H_{15}N_50$.

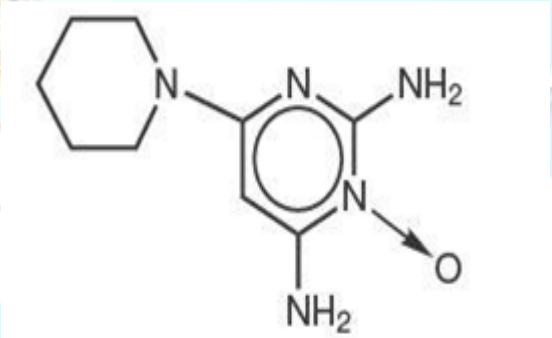

Fig no 1: Chemical Structure of Minoxidil (1)

Minoxidil is a powerful vasodialator, the pattern of action resembles hydralazine, i.e. direct relaxation of arteriolar smooth muscle with little effect on venous capacitance. Vasodialation elicts strong compensatory reflexes: increased rennin release and proximal tubular Na^+ and water retention edema and CHF may occur; increased sympathetic activity palpitation, increased cardiac output. To offset these, it has to be used along with a loop

diuretic and a β blocker.
Minoxidil is a prodrug converted to an active metabolite which is an opener of ATP operated K^+ channels, acts by hyperpolarizing smooth muscle. (19)

USE OF MINOXIDIL IN ALOPCEIA

Minoxidil increases growth of body hair. Applied topically it promotes hair growth in male pattern baldness and alopecia areata. The response is slow. The mechanism of increased hair growth is not known; may involve:

a. Enhanced microcirculation around hair follicles.
b. Direct stimulation of resting hair follicles.
c. Alteration of androgenic effect on genetically programmed hair follicles. (19)

Also, minoxidil is a growth stimulant that stimulates already-damaged hair follicles to produce normal hair. Minoxidil does not, however, provide any protection to the follicles from further DHT damage. When a follicle is destroyed by DHT minoxidil will no longer be able to have any more regrowth effects on that follicle.

LITERATURE REVIEW

Verma swati, et al, (2016), formulated the nanoemulgel for topical delivery of poor water soluble drug ketoconazole which is useful in the treatment of fungal infection. Formulations were prepared using different gelling agents i.e. carbopol 934 and carbopol 940. The highest activity was observed for the formulation which was based in the carbopol 934. The formulated nanoemulgel was found to be stable for 3 month with no major alterations and globule size under the range of 200nm indicates there is high degree of homogeneity.

Khuriah Abdul Hamid, et al (2015) concluded that the emulgel represent a solution for incorporating hydrophobic drugs as benzyl benzoate in water soluble gel bases. Thus it is recommended for formulation of benzyl benzoate since the release and consequently the effectiveness and availability of the medicament is greatly increased than other topical formulations and was noticed that addition of 20% of carbopol 934 gel is better than preparations containing 10 and 30%

Panwar Shailendra, etal, (2015), develops tioconazole emulgel for the topical delivery system which is useful in the treatment of vaginal infections using different polymer ratio. Thus, concluded that the formulation using 0.25% carbopol934 shows the greater release of drug as compared to others formulations with all aspects.

Ramakanth Ambala, et al, (2015), formulate the ketoprofen emulgels using different viscosity grades of HPMC and carbopol as gelling agents and concluded that emulgels containing HPMC were poor in clarity when compared to carbopol formulations. The influence of the type of gelling agent on the drug release from the prepared emulgel was investigated and carbopol showed the good results not only in the drug release but also in physical evaluation parameters.

Hardenia et al (2014) reviewed that in comparison to other group of semisolid preparations, the use of gels has been emerged both in cosmetics and in pharmaceuticals preparations because of its unique array of features. Despite of proving several benefits the category gel faces limitations in delivering hydrophobic drug molecules via skin. So in order to cover up this lacking a recent emulsion based approach is being used so that even a hydrophobic therapeutic moiety can enjoy the unique properties of gels. The use of gels and emulsions as combined dosage form results into formation of emulgel showing dual release.

Patil A. Suchita, et al, (2014), investigate the possibility of the dermal application of the etodolac with emulgel formulations. Furthermore, the effect of different concentration of oil phase on the drug release, viscosity and spreadability was investigated and emulgel was optimized using 23 factorial design. The developed emulgel were efficacious for the delivery of lipophilic and poorly soluble drugs such as Etodolac. Thus results demonstrate the formulation were stable and showed improved permeation of the drug from the emulgel compared to other emulgel formulations.

Shah A. Arpan et al (2013) concluded that emulgel s the one of the recent technologies in NDDS used for dual control release of emulsion and gel for topical use. In spite of many advantages of gels a major limitation is the delivery of hydrophobic drugs. So to overcome this limitation emulgels are prepared and with their use even a hydrophobic

drug can be used to prepare emulgels.

Sonaje et al (2013) surveyed that emulgels have been proven as most convenient, better and effective delivery systems. Due to its non-greasy, gel like property it provides and lack of oily bases and it provides better release of drug as compared to other topical drug delivery system. Incorporation of emulsions into gel makes it a dual control release system further problem such as phase separation, creaming associated with emulsion gets resolved and its stability improves.

Bhatt Preeti et al (2013) concluded that emulgel shows major advantages on novel vesicular systems as well as on conventional systems in various aspects. Emulgels for dermatological use have several favorable properties such as being thixotrophic, greaseless, easily spreadable, easily removable, emollient, non staining, water soluble, long shelf life, bio-friendly and please appearance. It also concluded that use of various permeation enhancers can potentiate the effect. So emulgels can be used as better topical drug delivery systems over present systems.

Kaushal R. Sabu, et al (2013) formulated the terbinafine hydrochloride emulgel using various variables such as oil phase and the emulsifying agents and was further optimized by the factorial design. A 22 factorial design was employed to identify optimal formulations parameters for an emulgel preparation with the minimum value of spreadability and max value of in-vitro drug release. Hence, the results of the study clearly indicating promising potentials of emulgel as sustained release for delivering terbenafine hydrochloride topically in the treatment of fungal infection and could be viewed as a potential alternative to conventional dosage forms.

Singla Vikas et al (2012) concluded that topical drug delivery will be used extensively due to better patient compliance. Since emulgel possesses an edge in terms of spreadability, adhesion, viscosity and extrusion and become a popular drug delivery system. Moreover, they will become a solution for loading hydrophobic drugs in a water soluble gel bases.

Ranga Priya M, et al (2012) reports for the development of ciprofloxacin emulgel for topical release of the drug. The results demonstrate that the release of the drug is dependent on viscosity of the polymer used. It can be conclusively stated that the emulgel formulations appears to be promising systems for the topical delivery of ciprofloxacin to avoid the disturbances of the conventional routes of administration.

Joshi baibhav, et al, (2012), concluded that Clarithromycin emulgel formulation prepared with either carbopol 934, carbopol 940 or HPMC showed acceptable physical properties, drug release, and antimicrobial activity, which remained unchanged upon storage for 3 months. However, the carbopol 934 based emulgel in its low concentration proved to be the formulae of choice, since it showed the highest drug release and very good antimicrobial activity when compared to the marketed Azithromycin gel. So it can be used as an antimicrobial broad spectrum medication for topical drug delivery.

Uprit Shubham, et al, (2012), prepared the nanostructured lipid carrier (NLC) gel, by using minoxidil, which is preferably used in case of alopecia, i.e. baldness pattern as an effective drug. It has been observed that NLC gel produces the gel with good consistency, homogeneity, spreadability and rheological behavior. They showed faster onset and elicted prolonged activity up to 16 hr. thus, the present study concluded that the NLC- based gel containing minoxidil dissolved in a mixture of solid lipid and liquid lipid in the nanostructure form helped them to attain the objective of faster onset yet prolonged actions as evident from in vitro release.

Magdy I.Mohamed (2004) develop an Emulgel formulation of chlophenesin (CHL) using two types of gelling agents: HPMC and Carbopol 934 and studied the influence of the type of gelling agent and concentration of both the oil phase and emulsifying agent on the drug release from the prepared emulgels was investigated using 23 factorial design. The prepared emulgels were evaluated for their physical appearance, rheological behavior, drug release, stability and other parameters.

Patent Related To Emulgel Preparations

Friedman, et al, 1993, patent no: US 6004566 A the invention relates to a delivery system which includes a bioactive drug or cosmetic substance pre-

sented in the form of submicron oil spheres alone, or drugs or cosmetic substances in a combination with the oil spheres in an aqueous suspension or emulsion. Optionally, a skin penetration enhancer may be included in such formulations. Such preparations achieve improved bioavailability and exert larger pharmacological effects than an equivalent dose of the drug or cosmetic formulated in conventional creams, lotions or oleaginous bases. This invention relates to a composition for topical application of pharmaceuticals or cosmetics comprising submicron size droplets of a drug with oily excipients either alone or dispersed in an aqueous medium. The droplet size is below one micron, and preferably in the range of about 0.05 to 0.5 microns. A semi-solid state is advantageous for the practical application of the dosage form on the skin when used as a cream. Specifically, the submicron size droplets include about 0.5 to 30% of a first component comprising an oily liquid, about 0.1 to 10% of a second component of an emulsifier and about 0.05 to 5% of a non-ionic surfactant. These droplets are suspended in an aqueous component which forms the continuous phase of an emulsion. The composition provides enhanced topical and/or transdermal systemic effects compared to similar compositions which have larger size droplets.

Falk Edgar Rudolf, et al, 1998, patent no: US 5824658 A invents a method of treating pain topically, said method comprising administering topically to the skin or exposed tissue of a human, a dosage amount of a pharmaceutical composition, said dosage amount comprising (1) a non-steroidal anti-inflammatory drug (NSAID) in a therapeutically effective amount to treat pain of the skin or exposed tissue and a form of hyaluronic acid selected from the group consisting of hyaluronic acid, its non-toxic salts and combination thereof being between 1% and 3% by weight of the composition, characterized in that said dosage amount of said composition is in a dosage form suitable for topical application to the skin or exposed tissue and in a dosage amount in which component exceeds 10 mg/cm2 of the skin or exposed tissue to which the dosage amount is to be applied, and is in such form that component is immediately available to transport component percutaneously into the epidermis of the skin or exposed tissue to the site of trauma or pathology of pain to be treated, in the skin or exposed tissue, and wherein the molecular weight of the form of hyaluronic acid is less than 750,000 daltons.

Jacek Ancerewicz, et al, 2002, patent no: WO2002017905A2, the invention relates to the topical use of diclofenac, and topically acceptable salts thereof, (for the manufacture of a topical medicament) for the topical treatment of burns.

Cavallari Cristina, et al, 2007, patent no: WO 2007129162 A2, the invention relates to formulations for transdermal use, particularly to formulations for pharmaceutical use, and to a use of such formulations for the preparation of pharmaceutical products. The synergic action of the derivative of colchicine and of the emulgel substantially improves the penetration to sub-cutaneous level of the substantially lipophilic compounds.

Fabienne Calillet Bois, et al, 2007 patent no EP2214642A1, invention concerns topical formulations comprising the well know and widely used on steroidal anti-inflammatory drug diclofenac in emulsion-gel form. The currently commercially most successful products of this kind is Voltaren® Emulgel® comprising 1.16% diclofenac diethylamine salt. The invention further relates to a method of treating inflammatory diseases including pain which comprises topically administering to a mammal in need of such treatment a therapeutically effective amount of one of the topical pharmaceutical compositions.

Cristina Cavallari, et al, 2009, patent no EP 2019666 A2 (WO2007129162A2, WO2007129162A3) invents the Pharmaceutical transdermal formulations containing thiocolchicoside and ibuprofen in emulgel are described. The present invention provided a transdermal formulation comprising an emulgel, a derivative of colchicines and an essentially lipophilic compound with pharmacological activity. It explains the synergic action of the derivative of colchicines and of emulgel substantially improves the penetration to sub-cutaneous levels of the substantially lipophilic compounds. In accordance with further aspects of the present invention, there is provided a transdermal formulation comprising a derivative of colchicines, ibuprofen and a pharmaceutically acceptable vehicle for the transdermal use.

MINOXIDIL

This compound belongs to the class of organic compounds known as dialkylarylamines. These are aliphatic aromatic amines in which the amino group is linked to two aliphatic chains and one aromatic group.

Minoxidil is at least 90% absorbed from the GI tract in experimental animals and man. Minoxidil does not bind to plasma proteins. Approximately 90% of the administered drug is metabolized, predominantly by conjugation with glucuronic acid at the N-oxide position in the pyrimidine ring, but also by conversion to more polar products. Known metabolites exert much less pharmacologic effect than minoxidil itself. (FDA guidelines) Its half life is 4.2 hours

Literature Review Of Minoxidil For Different Dosage Forms

Shatalebi M.A., et al, (2014), evaluate a minoxidil foamable emu oil emulsion with the purpose of improving minoxidil permeation into the skin, increasing hair growth, reducing skin irritation and increasing consumer compliance. The adopted formulations showed good pharmaceutical characteristics and was concluded the selected formulation exhibited a significant potency in promoting hair growth in comparison with marketed 5% minoxidil solutions Pakdaru.

Parhi Rabinarayan, et al, (2014), develop topical gel of minoxidil using model polymers such as Hydroxypropyl methylcellulose, K4M (HPMC K4M) and Hydroxypropyl cellulose (HPC) at different concentrations (1, 2 and 3%) individually and in combination. The release data of all the formulations were compared with the marketed formulation (Tugain gel).

Date B. Namrata, et al, (2014), formulated the coated micro needles and have been shown to deliver proteins and DNA into the skin in minimum invasive manner. The goal of the study was to enhance permeation of drug with the aid of microneedles, thus reducing the concentration of alcohol and damage of scalp cells.

Sampathi Sunitha, et al, (2014), aimed to investigate the effect of microemulsions and microemulsions based hydrogel systems (MEHs) for increased percutaneous penetration of minoxidil. MEH formulations were compared with the marketed topical solutions. The microemulsion did not show any dermatological reactions when tested. The microemulsion was found stable on storage and results suggested that microemulsions and MEHs could be more promising for topical delivery of minoxidil in hair loss treatment in comparison to solution based formulations.

Farouk M Sakr, et al, (2013), studied a multimodal microemulsion comprising minoxidil (a dihydrotestosterone antagonist), diclofenac (a nonsteroidal anti-inflammatory agent), and tea tree oil (an anti-infective agent). They investigated the stability and physicochemical properties of this formulation, and its therapeutic efficacy compared with a formulation containing minoxidil alone in the treatment of androgenic alopecia.

Review detail on minoxidil as emulgel:

George Eby et al, (2014), confirmed the feasibility of minoxidil emulgels over minoxidil gels for developing effective and safe topical delivery systems for the treatment of androgenic alopecia. Hence minoxidil emulgel was recommended as being more promising than gels

Polymer Profile

Following are the various polymers used in the formulation design of emulgel:

a. Carbopol 940
b. Carbopol 934
c. Hydroxypropyl methyl cellulose
d. Xanthan gum
e. Methyl cellulose

Literature Review Of Polymers

Effionora anwar, et al, 2014, measured the penetration ability of capsaicinoid through rat abdomen skin as membrane diffusion. Capsaicinoid was used as an active ingredient in emulgel and gel using carbopol 940 as gelling agent. The results revealed that penetration ability of emulgel dosage form is higher than gel and both of the dosage forms were physically stable.

Table no 1: Literature review of emulgel

S.No	Drug	Polymer used	References, year
1	Ketoconazole	Carbopol 934, Carbopol 940	Verma Swati, et al 2016
2	Benzoyl benzoate	10%, 20%, 30% of carbopol 934	Khuria Abdul Hamid, et al, 2015
3	Tioconazole	Carbopol 934	Panwar shailendra, et al, 2015.
4	Ketoprofen	HPMC and Carbopol	Ramakanth ambala, et al, 2015
5	Minoxidil	Carbopol 940	George eby, et al , 2014
6	Etodolac	Carbopol 940	Patil A Suchita, et al, 2014
7	Terbinafine	HPMC	Kaushal R sabu, et al, 2013
8	Ciprofloxacin	Carbopol 934	Ranga M priya, et al, 2012
9	Clarythromycin	HPMC, Carbopol 934, Carbopol 940	Joshi Baibhav, et al, 2012
10	Chlorphenesin	HPMC and carbopol 934	Magdy I. Mohammed, et al, 2004

Table no 2: List of patents

S.NO	PATENT NO	TITLE OF PATENT	INVENTORS	YEAR
1	EP2214642 A1	Topical composition	Fabienne Caillet-Bois, Isabelle Rault, Michel Steiger	2010
2	EP2019666 A2	Pharmaceutical preparations for transdermal use	Cristina Cavallari, Barbara Luppi, Pietra Anna Maria Di, Lorenzo Rodirguez	2009
3	2007129162	Pharmaceutical preparations for transdermal use	Cristina Cavallari, Barbara Luppi, Pietra Anna Maria Di, Lorenzo Rodirguez	1999
4	WO2002017905 A2	Treatment of burns	Ancerewicz Jacek, Kienzler Jean-Luc, Sallin Dominique, Schumann Phyllis	2002
5	US 6004566 A	Topical and transdermal delivery system utilizing submicron oil spheres	Doron Friedman, Joeph Schwartz, Haim Aviv	2007
6	5639738x	Topical composition containing hyaluronic acid and NSAIDs	Falk, Rudolf Edgar, Asculai, Samuel Simon	1995

Table no 3: Various Marketed Preparations of Emulgel with their Manufacturers

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

Table no 4: Literature Review of minoxidil for different dosage forms

S.No	Drug	Dosage form	Reference and year
1	Minoxidil	Emu oil emulsion	Shatalebi M.A, 2014
2	Minoxidil	Gel	Parhi Rabinarayan, 2014
3	Minoxidil	Microneedles	Date B. Namrata, 2014
4	Minoxidil	Microemulsions	Sampathi Sunitha, 2014
5	Minoxidil	Microemulsion	Farouk M Sakr, 2013

Table No 5: Literature Review of Polymers

S.No.	Drug	Polymers used	Reference and Year
1	Capsinoid	Carbopol 940	Effionora anwar, et al, 2014,
2	Indomethacin	Carbopol 934 and Xanthan Gum	Mulye P Snehal, et al, 2013
3	Ketoprofen	HPC and HPMC	Khaled M. Honsy, et al, 2013
4	Fluconazole	Carbopol 940, HPMC, Methyl Cellulose	Helal A Doaa, et al, 2012
5	ketoconazole	Carbopol 934 and Carbopol 940	Jain Ankur, et al, 2010

Mulye P Snehal, et al, 2013, develop and optimize the emulgel system for indomethacin using two types of gelling agents: Carbopol 934 and xanthan gum. In case of all evaluation parameters Xanthan gum based formulation showed better properties. So as general conclusion it was suggested that indomethacin emulgel formulation prepared with xanthan gum having the oil phase concentration in its low level and emulsifying agent concentration in its high level was the formulae of choice.

Khaled M. Honsy, et al, 2013, prepared ketoprofen emulgel to overcome the insolubility and irritating nature if the drug in the GIT which lead to ulceration and bleeding. Hydroxypropyl cellulose and Hydroxypropyl methyl cellulose were the two polymers used as gelling agents.

It concluded that topical emulgel enhanced permeation of ketoprofen and posses an effective anti-inflammatory activity, with avoidance of GIT adverse effect.

Helal A.Doaa, et al, 2012, formulated and evaluated the fluconazole topical gel. The gel was formulated by using different polymers with different concentration as carbopol 940, HPMC, me-

thyl cellulose, Pectin and Pluronic P407. Candida albicans was used as a model fungus to evaluate the antifungal activity of the prepared formulae achieved using Nizoral cream as control.

Jain Ankur, et al, 2010, investigate the potential of emulgel in enhancing the topical delivery of ketoconazole. Emulgel formulations of ketoconzole were prepared by using two types of gelling agents: carbopol 940 and carbopol 934. The antifungal activity of ketoconazole and drug release was found to be higher for optimized formulation as compared to the marketed ketoconazole cream.

Conclusion

Emulgels have been found to be novel approach for the treatment of various topical disorders. According to the various literature collected emulgels were found to be optimum over other topical preparations i.e. gel, cream, etc. Basic's of emulgel was studied through literature of emulgel which concluded the methodology, advantages and disadvantages of emulgel. Formulations related to minoxidil were reviewed and then concluded the review of minoxidil emulgel along with the marketed preparation of emulgel and patents of emulgel.

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