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FORMULATION DEVELOPMENT AND EVALUATION OF EMULGEL DRUG DELIVERY SYSTEM FOR THE TREATMENT OF PSORIASIS

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ABSTRACT

Mometasone furoate (MF) is a topical glucocorticoid having anti-inflammatory, anti-pruritic, anti-hyper proliferative activity. Owing to these properties it is recommended in chronic inflammation and psoriasis. In market, MF cream and lotion (0.1%) are available, which show slight skin irritation, burning and common side-effects due to steroids. To overcome the shortcomings of conventional formulations, there is a need to develop a novel formulation that can reduce these side-effects and show maximum desired effects. Thus, Emulgel can be prepared which would help in increasing skin deposition as well as provide sustained release. Developed formulations of Mometasone furoate were evaluated for the physiochemical parameters such as drug content, viscosity, spreadability, in vitro diffusion. Viscosity studies of various formulations revealed that formulation F4 is better compare to others. Release of drug from Mometasone furoate emulgel was significantly slower, which confirmed that slight prolonged drug release rate. Incorporation of carbomer affected the release rate of the drug. By increasing the amount of carbomer, the release rate of the drug decreased, which could be related to the increased rigidity of the formulation, followed by its decreased permeability for the drug. *In vitro* drug release from the semisolid preparation of Mometasone furoate emulgel optimized formulation F4 shows significantly improved in drug release rate as compare to marketed preparation.

KEYWORDS: Psoriasis, Formulation development, Carbopol 940, Mometasone furoate, Emulgel, In vitro drug release.

INTRODUCTION

Psoriasis is chronic inflammatory skin disarray that may drastically affect the feature of life of an affected person. Various treatments are presented for psoriasis and with this topical therapy are most generally used in majority of patients. Psoriasis has genetic and life manner triggers; the treatment guidelines involve continuous monitoring and lifelong care for the patients. Knowledge of the disease trigger factors and their part in precipitating the psoriasis is quiet significant in the disease management. Care should be taken to avoid these psoriasis triggers. In recent years, new biological therapies have been introduced and numerous existing treatments have been superior giving new anticipate to people with psoriasis.[1] Emulgel are also called as gellified emulsions. Emulsion in gel have emerged as one of the most interesting topical drug delivery system as it has dual release system i.e. emulsion and gel. Emulgel are emulsion, either oil-in-water or water-in-oil type, which are gelled by mixing with a gelling agent.[2] Most pharmaceutical drugs are lipophilic compounds, which are practically insoluble in water.[3] So to overcome this limitation an emulsion based approach is being used so that hydrophobic drug can be easily administered to the skin. An emulsion may be defined as a dispersion of two or more mutually insoluble liquids one in other. Mometasone furoate (MF) is a topical glucocorticoid having anti-inflammatory, anti-pruritic, anti-hyper proliferative activity. Owing to these properties it is recommended in chronic inflammation and psoriasis. In market, MF cream and lotion (0.1%) are available, which show slight skin irritation, burning and common side-effects due to steroids. To overcome the shortcomings of conventional formulations, there is a need to develop a novel formulation that can reduce these side-effects and show maximum desired effects. Thus, Emulgel can be prepared which would help in increasing skin deposition as well as provide sustained release.

MATERIAL AND METHODS

Material

Mometasone furoate obtained as gift sample from pharmaceutical company. Carbopol 934, HPMC, Methylparaben, Propylene glycol and Glutaraldehyde from Himedia Pvt. Ltd., All the chemical used for analysis were analytical grade. Triplled distilled water used throughout the study.

Method

Preparation of carbopol

Fifty grams of the carbopol gel was prepared by dispersing one gram of carbopol powder in 50 ml purified water with aid of moderate speed stirrer (50 rpm), and then the pH was adjusted to 6-6.5 using 0.5 N sodium hydroxide.

Preparation of emulsion

Different formulations F1, F2, F3, and F4, were prepared using Carbopol 934 as gelling agent whereas formulations F5, F6, F7 and F8 were prepared by dispersing HPMC in heated distilled water (80°C), and the dispersion was cooled and left overnight. The pH of all the formulations was adjusted to 6-6.5 using tri ethanol amine (TEA). The oil phase of the emulsion was prepared by dissolving Span 20 in light liquid paraffin, while the aqueous phase was prepared by dissolving Tween 20 and ethanol in purified water. Methylparaben was dissolved in propylene glycol and mixed with aqueous phase. Drug was dissolved in oil phase. Permeation enhancers were dissolved in the oily phase. Both the oily and aqueous phases were separately heated to 70° to 80°C, then the oily phase was added to the aqueous phase with continuous stirring until it got cooled to room temperature. The obtained emulsion was mixed with the gel in 1:1 ratio along with the addition of a few drops of glutaraldehyde followed by gentle stirring to obtain the Emulgel.[4]

Table 1: Different formulas of Mometasone furoate emulgel (% w/w).

Formulation	Mometasone furoate (g)	Carbomer 941 (g)	HPMC (g)	Liquid Paraffin (g)	Span 20 (g)	Tween	Propylene glycol
F1	500	1	-	5	1	0.5	5
F2	500	1	-	5	1	0.5	5
F3	500	1	-	5	1	0.5	5
F4	500	1	-	5	1	0.5	5
F5	500	-	1	10	2	1	5
F6	500	-	1	10	2	1	5
F7	500	-	1	10	2	1	5
F8	500	-	1	10	2	1	5

Evaluation of emulgel[5-11]

Physical Characteristic

The Physical Characteristic was checked for emulgel formulations (colour, clogging, homogeneity and texture) and observations were shown in Table.

Determination of pH

The pH of the emulgel was determined by digital pH meter. One gram of gel was dissolved in 25 ml of distilled water and the electrode was then dipped in to gel formulation for 30 min until constant reading obtained. And constant reading was noted. The measurements of pH of each formulation were replicated two times.

Washability

Formulations were applied on the skin and then ease and extent of washing with water were checked manually and observations were shown in Table.

Extrudability study

The emulgel formulations were filled into collapsible metal tubes or aluminium collapsible tubes. The tubes were pressed to extrude the material and the extrudability of the formulation was checked.

Spreadability

Two glass slides of standard dimensions (6×2) were selected. The emulgel formulation whose spreadability had to be determined was placed over one of the slides. The second slide was placed over the slide in such a way that the formulation was sandwiched between them across a length of 6 cms along the slide. 100 grams of weight was placed up on the upper slide so that the emulgel formulation between the two slides was traced uniformly to form a thin layer.

The weight was removed and the excess of the emulgel formulation adhering to the slides was scrapped off. The lower slide was fixed on the board of the apparatus and one end of the upper slide was tied to a string to which 20 gram load could be applied 50with the help of a simple pulley. The time taken for the upper slide to travel the distance of 6 cms and separate away from lower slide under the direction of the weight was noted. The experiment was repeated and the average of 6 such determinations was calculated for each emulgel formulation.

$$\text{Spreadability} = \frac{m.l}{t}$$

Where, S=Spreadability (gcm/sec)

m = weight tied to the upper slide (20 grams)

l= length of glass slide (6cms).

t = time taken is seconds.

Viscosity

The measurement of viscosity of the prepared gel was done using Brookfield digital Viscometer. The viscosity was measured using spindle no. 6 at 10 rpm and 25^0C. The sufficient quantity of gel was filled in appropriate wide mouth container. The gel was filled in the wide mouth container in such way that it should sufficiently allow to dip the spindle of the Viscometer. Samples of the gels were allowed to settle over 30 min at the constant temperature (25±/1^0C) before the measurements.

***In-vitro* drug release studies using the prehydrated cellophane membrane**

Preparation of cellophane membrane for the diffusion studies

The cellophane membrane approximately 25 cm x 2cm was taken and washed in the running water. It was then soaked in distilled water for 24 hours, before used for diffusion studies to remove glycerin present on it and was mounted on the diffusion cell for further studies.

Diffusion Studies

The *in-vitro* diffusion of drug from the different gel preparations were studied using the classical standard cylindrical tube fabricated in the laboratory; a simple modification of the cell is a glass tube of 15mm internal diameter and 100mm height. The diffusion cell membrane was applied with one gram of the formulation and was tied securely to one end of the tube, the other end kept open to ambient conditions which acted as donor compartment. The cell was inverted and immersed slightly in 250 ml of beaker containing neutralizing phthalate buffer, freshly prepared (pH 5.4) as a receptor base and the system was maintained for 2 hrs at 37± 0.5^{o}C. The media was stirred using magnetic stirrer. Aliquots, each of 5 ml volume were withdrawn periodically at predetermined time interval of up to 12 hrs and replaced by an equal volume of the receptor medium. The aliquots were suitably diluted with the receptor medium and analyzed by UV-Vis spectrophotometer at 260.0 nm using neutralizing phthalate buffer as blank.

RESULTS AND DISCUSSION

A suitable method of analysis of drug was UV spectrophotometric. Mometasone furoate showed maximum absorption at a wavelength of 260nm. Various formulations (F1-F8) were

developed by using Carbopol 940 for local release of Mometasone furoate for the treatment of topical infections by using penetration enhancer Tween 80. Developed formulations of Mometasone furoate were evaluated for the physiochemical parameters such as drug content, viscosity, spreadability, in vitro diffusion. Viscosity studies of various formulations revealed that formulation F4 is better compare to others. Release of drug from Mometasone furoate emulgel was significantly slower, which confirmed that slight prolonged drug release rate. Incorporation of carbomer affected the release rate of the drug. By increasing the amount of carbomer, the release rate of the drug decreased, which could be related to the increased rigidity of the formulation, followed by its de-creased permeability for the drug. *In vitro* drug release from the semisolid preparation of Mometasone furoate emulgel optimized formulation F4 shows significantly improved in drug release rate as compare to marketed preparation.

In vitro drug release from the semisolid preparation of Mometasone furoate emulgel optimized formulation F4 shows significantly improved in drug release rate as compare to marketed preparation. It was concluded that developed formulations deliver the drug for the treatment of fungal disease. Hence it could be concluded that the carbomer based semisolid preparation would providing local onset of action without need of any device for their application on skin. The preparation of emulgel has potential advantages over marketed preparation as they improved patient compliance rapid local onset of action for longer period with cost effectiveness. The pediatric and geriatric populations are the primary ones whose problems are easily targeted.

Table 2: Psychorheological Characteristic.

Formulation	Washability	Observation	Extrudability
F1	+++	white cream	++
F2	+++	white cream	+++
F3	+++	white cream	+++
F4	+++	white cream	+++
F5	++	white cream	++
F6	++	white cream	++
F7	++	white cream	+++
F8	++	white cream	++

Washability - Excellent: +++, Good: ++, Average: +, Poor: -

Table 3: Extrudability and Spreadability study.

Formulation	Spreadability (gcm/sec)	Viscosity (cps)	pH
F1	11.11±1.23	2569	6.5
F2	10.23±0.89	2365	6.8
F3	11.56±0.87	2789	6.5
F4	12.32±0.58	2654	6.6
F5	9.85±0.45	1984	6.8
F6	8.65±0.65	1950	6.5
F7	9.12±0.12	1898	6.7
F8	7.98±0.32	1812	6.8

Table 4: % Cum. drug release of formulation F1-F8.

Time	F1	F2	F3	F4	F5	F6	F7	F8
0	0	0	0	0	0	0	0	0
15	15.65	18.98	23.36	25.65	11.23	16.65	15.65	11.23
30	28.65	32.25	36.65	40.23	18.98	22.36	23.36	20.14
45	36.56	46.65	40.12	46.65	25.65	28.98	34.56	31.56
60	46.56	58.98	58.98	55.65	33.36	36.65	40.25	39.98
120	55.65	72.25	78.98	88.98	48.98	50.14	55.65	45.65
240	78.98	87.98	95.56	98.89	56.69	62.12	69.98	52.12

Table 5: *In Vitro* Drug Release Data for optimized formulation F4.

S. No.	Time (min)	Square Root of Time	Log Time	Cumulative* Percentage Drug Release ± SD	Log Cumulative Percentage Drug Release	Cumulative Percent Drug Remaining	Log cumulative Percent Drug Remaining
1	15	3.873	1.176	25.65	1.409	74.35	1.871
2	30	5.477	1.477	40.23	1.604	59.77	1.776
3	45	6.708	1.653	46.65	1.668	53.35	1.727
4	60	7.746	1.778	55.65	1.745	44.35	1.646
5	120	10.954	2.079	88.98	1.940	11.02	1.042
6	240	15.492	2.38	98.89	1.995	1.11	0.0453

CONCLUSION

It was concluded that developed formulations deliver the drug for the treatment of fungal disease. Hence it could be concluded that the carbomer based semisolid preparation would providing local onset of action without need of any device for their application on skin. The preparation of emulgel has potential advantages over marketed preparation as they improved patient compliance rapid local onset of action for longer period with cost effectiveness. The pediatric and geriatric populations are the primary ones whose problems are easily targeted.

REFERENCES

1. Saraswat A, Agarwal R, Katare OP, Kaur I, Kumar B. A randomized, double blind, vehicle controlled study of a novel liposomal dithranol formulation in psoriasis. J Dermatol Treatment, 2007; 18: 40-45.
2. Lopes LB, Speretta FF, Bentley MV. Enhancement of skin penetration of vitamin K using monoolein-based liquid crystalline systems. Eur J Pharm Sci, 2007; 32: 209–215.
3. Benson HAE. Transdermal drug delivery: penetration enhancement techniques. Curr Drug Deliv, 2005; 2: 23-33.
4. Kiran Vema, Formulation & Evaluation of Aceclofenac Emulgel, Journal of Advanced Pharmaceutical Technology & Research, 2015; 3(1): 52-57.
5. Khuriah Abdul Hamid, Salizatul Ilyana Ibrahim, Muhammad Azril Hashim and Mohamed Salama, Journal of Pharmacy and Biological Sciences, 2015; 10(3): 06-09.
6. Kishor V. Nikumbh, Shailesh G. Sevankar, and Moreshwar P. Patil, Formulation development, *in vitro* and *in vivo* evaluation of microemulsion-based gel loaded with ketoprofen, Drug Deliv, 2015; 22(4): 509–515.
7. Kumar Bandhu Lathiyare, Preeti K. Suresh, Vishal Jain, Development and In Vitro Characterization of Piroxicam Loaded Emulgel for Topical Delivery, Ijppr. Human, 2015; 2(3): 18-32.
8. Vijay Swami, Kuchekar BS, Swati Jagdale, Development and Optimization of Site Targeted Topical Delivery of Norfloxacin Emulgel, Research & Reviews: Journal of Pharmaceutics and Nanotechnology, 2015; 3(3): 22-34.
9. V. Naga Sravan Kumar Varma, P.V. Maheshwari, M. Navya, Sharath Chandra Reddy, H.G. Shivakumar, D.V. Gowda, Calcipotriol delivery into the skin as emulgel for effective permeation, Saudi Pharmaceutical Journal, 2014; 22: 591–599.
10. I.I. Berdey, O.I. Voyt, Rheological properties of emulgel formulations based on different gelling agent, The Pharma Innovation Journal, 2016; 5(4): 76-79.
11. Kirti Kumari, UVS. Sara and Monika Sachdeva, Formulation and Evaluation of Topical Hydrogel of Mometasone Furoate using Different Polymers, International Journal of Pharmaceutical and Chemical Sciences, 2013; 2(1): 89-100.