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Research Article

DEVELOPMENT AND EVALUATION OF ANTI-DANDRUFF HAIR GEL

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ABSTRACT

In the present study, an attempt was made to develop Clotrimazole Anti-Dandruff hair gel. The different formulation were developed using polymers such as Corbopol 940, Corbopol 934, PEG 200 etc. These polymers were selected based on their use in gel formulation. All the formulations were evaluated Active Content, Physical appearance, P^H, Viscosity, Extrudability, Antifungal activity, Drug release Profile, Compatibility and Stability study. In Stability study, formulation F7 was shows no appreciable changes as compared to other formulation during the study period of three months. Formulation F7 was shows maximum zone of inhibition to an Anti-fungal activity during *in vitro* study. Therefore F7 could be used as an effective formulation for Anti-Dandruff hair gel of clotrimazole as compared to other formulation.

Keywords: Anti-Dandruff hair gel, Clotrimazole, Stability study and *in vitro* study.

INTRODUCTION

Dandruff is a common embarrassing disorder which effects 5% of the global population[1]. *Pityrodporium Ovale* is strongly suspected to play a role in the manifestation of the seborrheic dermatitis[2, 3]. Currently available treatment options for the management of dandruff include therapeutic use of zinc pyrithione, salicylic acid, imidazole derivatives, glycolic acid, steroids, and sulphur and coal tar derivatives. However, these agents show certain limitations, either due to poor clinical efficacy or due to the compliance issues. Further more, these drugs are unable to prevent recurrence[4]. Clotrimazole is a broad spectrum synthetic antifungal agent having the chemical name 1-(o -Chloro-(alpha), (alpha)-diphenylbenzyl) imidazole and Empirical formula $C_{22}H_{17}ClN_2$, used in the treatment of variety of fungal infections. Various Antifungal agents are widely used in hair shampoos for the treatment of dandruff. These products show temporary effect for span of hours in a day on the scalp. Therefore, an attempt has been made for formulation of Clotrimazole Anti-dandruff hair gels which may give antidandruff action for number of hours.

MATERIALS AND METHODS

Clotrimazole was procured from halcyon labs, pvt, ltd, Mumbai, India. Carbopol 940, Corbopol 934, PEG 200, propyl paraben , methyl paraben were procured from SD fine chemicals, Mumbai., India and all others

chemicals and reagents were of either analytical or laboratory graded were used.

Instruments used for the study

Digital weighing balance (Shimazdu Electronics), pH Meter (Elico pH Meter, Hyderabad), Brook field viscometer (Startech Lab,Hyderabad), I.R.spectrophotometer (Startech Lab, Hyderabad) and Mechanical stirrer (Remi Motors Ltd, Mumbai).

METHODS

Formulation of Anti-dandruff hair gel

Measured quantity of methyl paraben, glycerin and weighed quantity of polyethylene glycol were dissolved in about 35 ml of water in beaker. Then it was stirred at high speed using mechanical stirrer.Then carbopol 940 and PVP were added slowly to the beaker containing above liquid while stirring. Crushed menthol was incorporated slowly in above dispersion after smooth dispersion is obtained. Then Triethanolamine (gelling agents) was added slowly while stirring till to attain gel structure. The clotrimazole was levigated using stainless steel spatula and porcelain slab.The gel was finally transferred in aluminum collapsible tube and labeled accordingly. The details of formulations were shown in table no 1 and 2.

Characterization of Hair gels (IR Studies)

The prepared hair gel formulations were tested for compatibility of the drug with gelling agents using IR studies. IR studies confirmed absence of drug, gelling agents interactions with hair gel formulations F5 to F8. Drug & Gelling agents interactions were observed with hair gel formulations F1 to F4. Hence, F5 to F8 hair gel formulations were selected for further studies in this present investigation.

Evaluation of Anti-dandruff hair gel

Physical appearance

The physical appearance was visually checked for the texture of hair gel formulations and observations were shown in Table – 3.

pH determination of formulations

The pH of all hair gel formulations were determined by using the digital pH meter. Electrodes were completely dipped into the hair gel formulations and pH was noted. The results are presented in Table-3.

Extrudability determination of formulations

The hair gel formulations were filled into collapsible metal tubes. The tubes were pressed to extrude the material and the extrudability of the formulation was checked. The comparative extrudability of the hair gel formulations is shown in Table-3.

Viscosity Determination of formulations

Brook field viscometer was used to determine viscosity. The sufficient quantity of gel was filled in wide mouth jar separately the height of the gel was filled in the wide mouth jar should sufficiently allow to dip the spindle. The RPM of the spindle was adjusted to 2.5 RPM. The viscosities of the formulations were recorded. The results of viscosity of gel formulations are shown in the Table-3.

Determination of drug content of formulations

For estimating the drug content of the hair gel formulations for F1 to F8, the common procedure was followed. About 500 milligrams of the above hair gel formulations were separately weighed and then each hair gel formulation is separately dissolved in 50 ml of methanol. Then the above volumetric flask containing formulation should shake for 15 minutes for the extraction of drug from the gel. Then dissolved drug was titrated with perchloric acid as the method described in B.P.1 ml of *0.1*M *perchloric acid* is equivalent to 34.48 mg of $C_{22}H_{17}ClN_2$. The amount of clotrimazole present was calculated and depicted in Table-3.

***In-vitro* study**

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 100 ml of phosphate buffer pH 7.4 as a receptor base and the system was maintained for 2 hrs at 37 ± 0.5^{o} C. The sample was withdrawn at the 10 minutes interval of

the time for 2 hrs. The media was stirred using magnetic bead hot plate magnetic stirrer.

Titrimetric measurement

10 ml of samples were withdrawn and transferred to conical flasks at 20 minutes interval for 2 hours and replenished with fresh media 10 ml. The clotrimazole content was estimated titrimetrically as described in B.P.1 ml of *0.1*M *perchloric acid* is equivalent to 34.48 mg of $C_{22}H_{17}ClN_2$. *In-vitro* diffusion profile, namely cumulative drug release was calculated and shown in Tables – 4 to 7 & Figures - 1to 8. The diffusion of the drug form the selected hair gel formulations were compared with marketed formulations. The results were shown in Table -8 & Figure – 9.

Antifungal activity

The hair gel formulation (F5 to F8) which showed optimal release was subjected to antifungal activity by adopting disc diffusion method at Startech Labs, Hyderabad. The test organizing was *Pityrodporium Ovale (*strain 27) in sabouraud's dextrose agar media. Commercial Clotrimazole ointment was taken as standard. Clotrimazole is a well known effective antifungal drug and it is available as a topical formulation. The results are recorded in Table -9.

Stability Studies

The hair gel formulation F7 was subjected to stability performance as it was exhibited good drug release and exhibited maximum zone of inhibition when compared to other formulations. The gel formulation F7 which was filled earlier in collapsible tube was stored at room temperature and 40°C at 75% RH. The stability study was conducted for the period of 3 months. The parameters like Appearance, pH, Extrudability, Colour, % drug content were tested at the every month. The results were shown in Table – 10.

RESULT AND DISCUSSION

Active content and physical appearance

The formulations evaluated for the active content. The results were found in acceptable range and % of drug content shown in table no 3.

pH determinations

It was found that all the formulations have pH in range 6.80 to 7.11 that suited the hair, indicating the hair compatibility and shown in table no 3.

Viscosity Determination

The viscosity of formulation F (6) was found to be highest and viscosity of formulation F (1) found to be least at 2.5 RPM.and they were showed in table 3.

Extrudability determination

The results of the Extrudability indicate that the F5 to F8 had better Extrudability than F1 to F4. All formulation showed good Extrudability when extruded from metallic collapsible tube (Table –3).

***In-Vitro* study**

Diffusion Study

In vitro diffusion study was carried out using the procedure as described earlier. The release profiles of the formulations are shown in the Table-4 to 7 and in the Figures- 1 to 8.

Comparative Drug Release Profile

Comparative *in vitro* drug release profile is shown in the Table – 8 and Figure-9.

Compatibility study

The prepared hair gel formulations were tested for compatibility of the drug with gelling agents using IR studies (as shown in charts.) IR studies confirmed absence of drug, gelling agents interactions with hair gel formulations F5 to F8. Drug & Gelling agents' interactions were observed with hair gel formulations F1 to F4. Hence, F5 to F8 hair gel formulations were selected for further studies in this present investigation.

Antifungal activities

Among the formulations, F7 showed better release and maximum zone of inhibition than other formulation. Hence, Hair gel formulation F7 was considered as best formulation as shown in the Table – 9.

Stability Study of the Formulation F7

The hair gel formulation F7 was subjected to stability performance as it was exhibited good drug release and exhibited maximum zone of inhibition when compared to other formulations. The stability study was conducted for the period of 3 months. The parameters like Appearance, pH, Extrudability, Colour, % drug content were tested at the every month. No appreciable

changes were found for the tested parameters. The results were shown in Table – 10.

CONCLUSION

The formulation of Anti-dandruff hair gel provides a method for treating a scalp dandruff or seborrheic dermatitis. Anti-dandruff hair gel containing 1.5% (F7) of Clotrimazole with Corbopol 940 base could be used as an effective in treatment of Dandruff on scalp.

Table 1: Formulae of Hair Gels

Ingredients	F_1	F_2	F_3	F_4
Clotrimazole	0.5	1.0	1.5	2.0
Carbopol 940	0.20 gm	0.20 gm	0.20 gm	0.20 gm
Polyethylene glycol	15 gm	15 gm	15 gm	15 gm
Alcohol	15 ml	15 ml	15 ml	15 ml
Water	20 ml	20 ml	20 ml	20 ml

Table 2: Formulae of Hair Gels

Ingredients	F_5	F_6	F_7	F_8
Clotrimazole	0.5	1.0	1.5	2.0
Carbopol 940	0.30 gm	0.30 gm	0.30 gm	0.30 gm
Polyethylene glycol	7.0 gm	7.0 gm	7.0 gm	7.0 gm
Methyl paraben	0.075 gm	0.075 gm	0.075 gm	0.075 gm
Poly vinyl Pyrrolidone	0.05 gm	0.05 gm	0.05 gm	0.05 gm
Menthol	0.5 gm	0.5 gm	0.5 gm	0.5 gm
Triethanolamine	0.6 ml	0.6 ml	0.6 ml	0.6 ml
Glycerin	3.0 ml	3.0 ml	3.0 ml	3.0 ml
Water Q.S.	50 ml	50 ml	50 ml	50 ml

Table 3: Evaluation of Hair Gels (Physico-Chemical Characteristics)

S.No	Product	Appearance	pH*	Extrudability *	% drug content*	Viscosity (cps)
1	F1	Translucent, off white, smooth on application	6.80	++	95.5	90,00,007
2	F2	Translucent, off white, smooth on application	6.82	++	96.6	90,00,015
3	F3	Translucent, off white, smooth on application	6.81	++	96.7	90,00,130
4	F4	Translucent, off white, smooth on application	6.82	++	96.2	90,00,105
5	F5	Translucent, off white, smooth on application	6.91	+++	97.1	90,00,169
6	F6	Translucent, off white, smooth on application	6.93	+++	97.7	90,00,235
7	F7	Translucent, off white, smooth on application	7.01	+++	97.5	90,00,098
8	F8	Translucent, off white, smooth on application	7.11	+++	98.1	90,00,195

*Each reading is an Average of three determinations
Excellent = +++, Good = ++.

Table 4: In-vitro Drug Release Profile of Hair gel (F5)

S. No.	Time (in min)	% of drug released	% of drug remaining	Log % of drug remaining
1	20	5.26	95.74	1.981
2	40	10.57	89.43	1.951
3	60	23.84	76.16	1.881
4	80	39.86	60.14	1.779
5	100	42.89	57.11	1.756
6	120	45.94	54.06	1.732

* Each reading is an average of three determination

Table 5: *In-Vitro* Drug Release Profile of Hair Gel (F6)

S. No.	Time (in min)	% of drug released	% of drug remaining	Log % of drug remaining
1	20	6.71	93.29	1.969
2	40	12.32	87.68	1.942
3	60	24.40	75.60	1.878
4	80	36.83	63.17	1.801
5	100	48.52	54.48	1.736
6	120	54.58	45.42	1.657

* Each reading is an average of three determinations

Table 6: *In-Vitro* Drug Release Profile of Hair gel (F7)

S. No.	Time (in min)	% of drug released	% of drug remaining	Log % of drug remaining
1	20	10.21	89.79	1.953
2	40	25.32	74.68	1.873
3	60	35.37	64.63	1.810
4	80	40.72	59.28	1.772
5	100	45.58	54.42	1.735
6	120	56.78	43.22	1.635

* Each reading is an average of three determinations

Table 7: *In-Vitro* Drug Release Profile of Hair gel (F8)

S. No.	Time (in min)	% of drug released	% of drug remaining	Log % of drug remaining
1	20	8.51	91.49	1.961
2	40	22.15	77.85	1.891
3	60	34.82	65.18	1.814
4	80	39.52	60.48	1.781
5	100	41.45	58.55	1.767
6	120	46.58	53.42	1.727

* Each reading is an average of three determinations

Table 8: Comparative *In-Vitro* Drug Release profiles of Hair Gels (F5 to F8)

S. No.	Time	% of drug release			
		F5	F6	F7	F8
1	20	5.26	6.71	10.21	8.51
2	40	10.57	12.32	25.32	22.15
3	60	23.84	24.40	35.37	34.82
4	80	39.86	36.83	40.72	39.52
5	100	42.89	48.52	45.58	41.45
6	120	45.95	54.58	56.78	46.58

* Each reading is an average of three determinations

Table 9: Anti Fungal Activity

S.No.	Formulation	Zone of inhibition average diameter
1	F5	10
2	F6	18
3	F7	28
4	F8	28
5	CF	25

Table 10: Stability Studies of Formulation F7

Sl. No.	Parameters	Observation						
		Initial	First month		Second month		Third month	
			RT	40°c	RT	40°c	RT	40°c
1	pH	7.01	6.97	6.99	7.14	7.14	7.15	7.15
2	Extrudability	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
3	% drug content	97.5	97.7	97.5	97.5	97.4	97.4	97.4
4	Appearance	Translucent & smooth.	Translucent & smooth.	Translucent & smooth.	Translucent & smooth.	Translucent & smooth.	Translucent & smooth.	Translucent & smooth.

* Each reading is an average of three determinations.

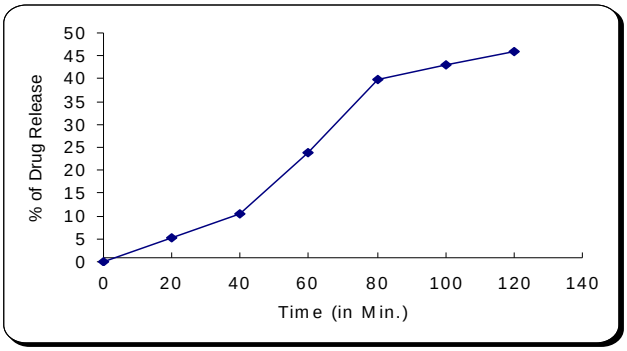

Fig. 1: In-vitro Drug Release Profile of Hair gel (F5)

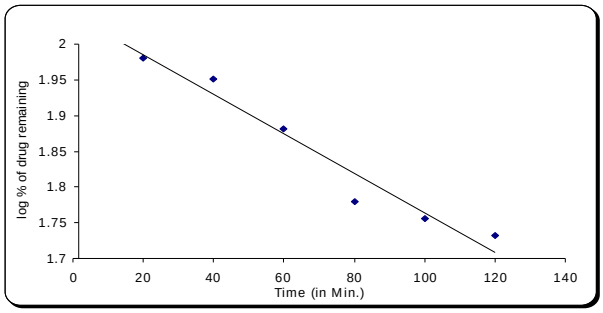

Fig. 2: 1st order drug Release profile of hair gel (F5)

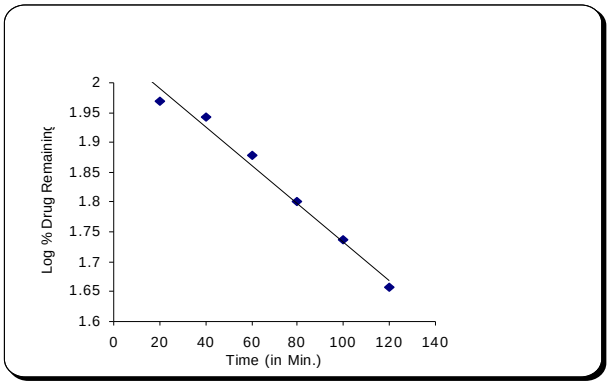

Fig. 3: In-Vitro Drug Release Profile of Hair Gel (F6)

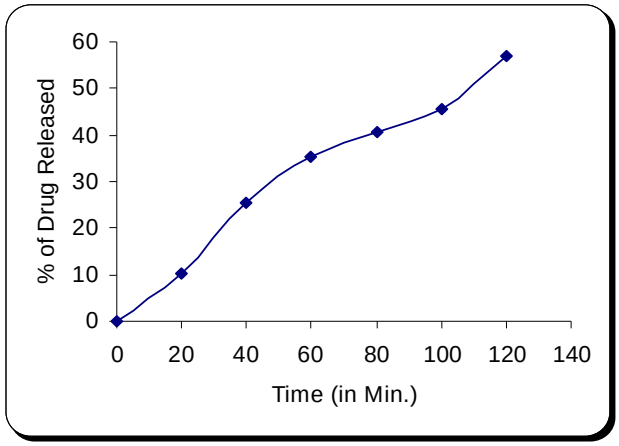

Fig. 4: 1st Order Drug Release Profile of Hair Gel (F6)

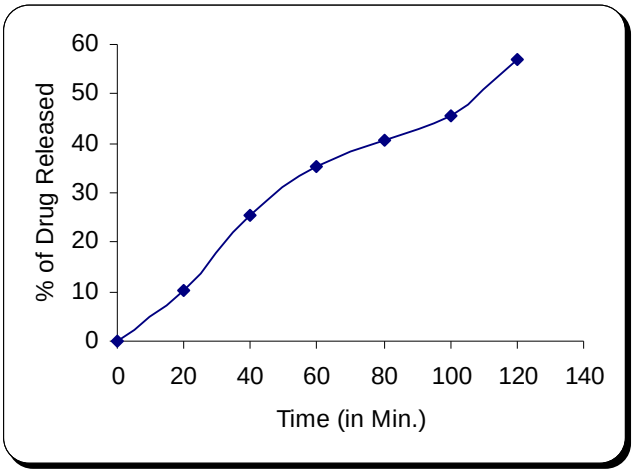

Fig. 5: In-Vitro Drug Release Profile of Hair gel (F7)

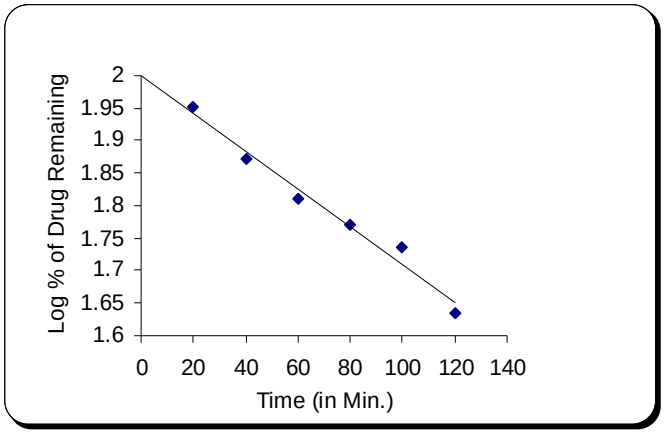

Fig. 6: 1st order Drug Release Profile of Hair gel (F7)

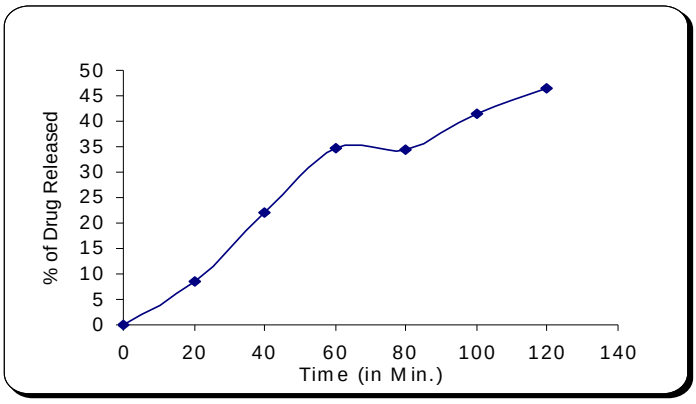

Fig. 7: In-Vitro Drug Release Profile of Hair gel (F8)

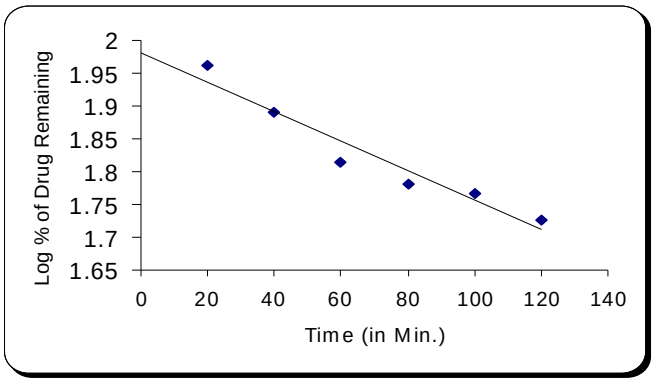

Fig. 8: 1st order Drug Release Profile of Hair gel (F8)

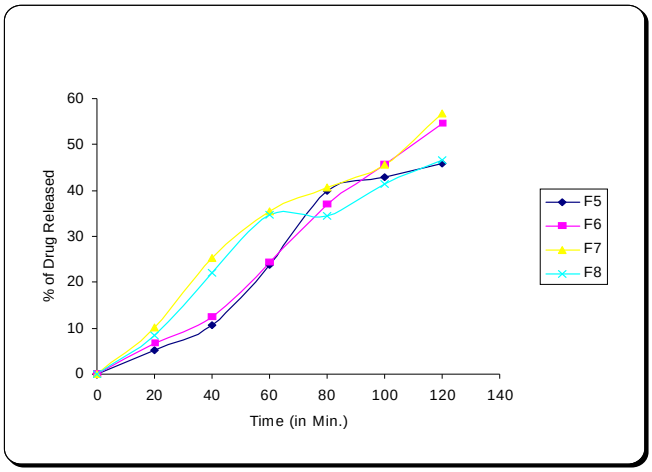

Fig. 9: Comparative In-Vitro Drug Release profiles of Hair gels (F5 to F8)

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