IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Formulation And Evaluation Of Minoxidil Loaded Aloe Vera Gel

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ABSTRACT

The current research work is intended to articulate Minoxidil loaded Aloe vera gel using simple and cost-effective method. Gel was prepared by "Homogenization method" using different polymers like HPMC and HPC, and gelling agent like carbopol-934. Further, they were evaluated for spread ability, extrudability and *in-vitro* dissolution studies.The completed batch drug content was determined as 93.281.25 by F2. The viscosity and spread ability of the formulation were excellent. The Kors Meyerpoppas release model was suggested by mathematical modelling of the drug release data. Overall, the Minoxidil gel formulation proved safe to use on the skin and might be an effective dose form.

Keywords: Minoxidil, Aloe vera, HPMC, HPC, Carbopol-934, spread ability, skin permeation.

INTRODUCTION

One of the drug delivery systems used since ancient time is Topical Drug Delivery System (TDDS). The application of medicinal substance to skin or to various body orifices is as old as humanity.

In recent year, topical medication delivery is a topic of great interest, since it has less systemic adverse effects than parenteral and/or oral drug administration. There is increased in utilization of translucent gels in pharmaceutical formulations and cosmetics because of these features within the principal class of semisolid preparations (1).

With recent advancements in drug delivery methods, the development of innovative gel systems for regulated, prolonged, and targetable drug administration locally or systemically has been initiated. As a result, "smart gel systems" for diverse applications are being devised and evaluated that respond to particular biological or environmental stimuli such as pH, temperature, ionic strength, antigens, enzymes, magnetic field, light, ultrasound, and electric current. Gels are common delivery methods because they are

easy to make and may be used to manage medications via many routes because they enable close contact between the therapeutic agent and absorption site.

MATERIALS AND METHODS

Materials

Minoxidil was purchased from Balaji Chemicals, Surat, Carbopol-934, Propylene glycol were purchased from Nice Laboratories Reagents, Kochi and Aloe vera is taken from local area for preparation of Minoxidil loaded Aloe vera gel.

FORMULATION OF MINOXIDIL GEL

Minoxidil-stacked Aloe vera gel was arranged utilizing the homogenization cycle. Minoxidil gel readiness: weigh 2 g of Minoxidil and broken down it in a dissolvable mix (propylene glycol, ethanol, and water). Then add required measure of polymer (s) to the arrangement while it was continually mixed at 500 rpm for about 2 hours utilizing an attractive stirrer (Remi, India). To limit air entanglement, the speed was subsequently brought down. Triethanolamine was utilized to kill the arrangement.

FORMULATION OF ALOE VERA GEL

- Extraction of Aloe Vera Gel The thick and pleasant leaves of the Aloe vera plant (Aloe barbadensis) were edited from the herb garden of R.K.S.D Pharmaceutical University in Caesar. The leaves of aloe vera are spliced together, washed with water and a medium chlorine solution, then temporarily chopped to remove the aloe vera and the sticky jam is removed from the center (substantial) of the leaves of the aloe vera plant. The thick epidermis was specially scraped with a vegetable peeler to separate, grind and blender homogenize the inner gel-like pulp in the center of the leaf. (2).
- Preparation of aloe vera gel Carbopol934 aloe vera gel was prepared by dissolving methylparaben sodium and propylparaben sodium in water. After adding the gelling component and stirring constantly, it was completely swollen (3). Triethanolamine was gradually added to the dispersion with continuous stirring to give a hard gel.It was then mixed with aloe extract for 15 minutes. Water was used to make the volume, which was continually agitated until a homogenous gel was created. Composition of Minoxidil gel batches that do not contain Aloe vera gel (F1) and Minoxidil loaded Aloe vera gel batches (F2-F8).

❖ Minoxidil gel and aloe vera gel are mixed with each other in 1:1.

Table 1: Composition of batches of Different Formulations

Ingredients	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8
Minoxidil (gm)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Carbopol-934 (gm)	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3
Aloe vera (gm)	0.0	1.0	1.5	1.5	1.0	1.0	1.5	1.5
Propylene glycol (ml)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Ethanol (ml)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Methyl Paraben (gm)	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Purified water (q.s upto ml)	20	20	20	20	20	20	20	20

EVALUATION OF FINALIZED BATCH

Spread ability study

The variance factor was estimated using a block of wood and a glass slide. A 20-gram weight was added to the pan and the time it took for the top slide (movable) to completely separate from the fixed slide was recorded(4). The Formula is used to determine the Spread ability.

S = M.L/T

M= wt. tied to upper slide

L=Length of glass slide

T= Time taken to separate the slide

Were

Extrudability study

A 15 gm of Minoxidil Gel and Minoxidil stacked aloe vera gel was filled in Aluminum tube. The unclogger was acclimated to hold the cylinder appropriately. The heaviness of 1kg/cm2 was applied for 30 seconds the amount of gel expelled was gauged (5).

Rheological Studies

Viscosity of the prepared Minoxidil Gel and Minoxidil loaded aloe vera gel were measured byDigital Rotational viscometer (LABMAN SCIENTIFIC, LMVD-60) using spindle 2 or 3 at 0, 3, 6, 12, 30 and 60 rpm at the temperature of 37^{o}C. The formulation was added to the beaker, Spindle number 3 was lowered perpendicular in to the center of different gels taking care that spindle does not touch bottom to the jar and rotated at a 3 (minimum) and 60 (maximum) rotations per minute, the viscosity was noted down (6).

Statistical analysis

The delivery examples of all details were contrasted with those of the unadulterated medication utilizing the similitude factor (f2), which is communicated as f2 = 50 log [1 + 1/n nn-1(Rt tt)2]0.5 100, where n is the quantity of time focuses. The percent prescription delivered at each time point for the reference and test, individually, is Rt and Tt. To accomplish the greatest likeness, the comparability elements of all still up in the air in contrast with Tugain gel. Also, examinations between the made definitions were finished. • If the comparability factor (f2) is somewhere in the range of 50 and 100, the two delivery profiles are probably going to be practically identical (7).

RESULT AND DISCUSSION

Spread ability

Spread ability of F1 was found to be 6.48 g.cm/sec. which is very low as compare to others. Spread ability of F2 was found to be 23.80 g.cm/sec, indicating better spread ability of gel as compared to other batches. The spread ability coefficient values of all formulations were illustrated in Table 2.

Table 2:Spread ability coefficient of Gel Formulations

Sr. No.	Formulation Code	M (gm)	L (cm)	T (sec.)	S=M*L/T (g.cm/sec.)
1.	F_1	20	5.0	15.42	6.48
2.	**F_2**	**20**	**5.0**	**4.20**	**23.80**
3.	F_3	20	5.0	7.62	13.12
4.	F_4	20	5.0	7.36	13.58
5.	F_5	20	5.0	5.05	19.80
6.	F_6	20	5.0	4.91	20.36
7.	F_7	20	5.0	5.71	17.51
8.	F_8	20	5.0	6.42	15.57

Extrudability Study

Extrudability of Aloe vera gel containing formulation F2 was founder higherthan no Aloe vera gel containing formulation F1. The Extrudability values of different formulations were elaborated in Table 3.

Table 3: Extrudability of Gel Formulations

Sr. No.	Formulation code	Wt. Extruded from the tube (gm)
1.	F_1	0.61±0.03
2.	**F_2**	**1.08±0.08**
3.	F_3	0.68±0.12
4.	F_4	0.92±0.06
5.	F_5	0.81±0.04
6.	F_6	0.91±0.06
7.	F_7	0.75±0.11
8.	F_8	0.67±0.12

Rheological Study

Highest viscosity was found in formulation F_2.The values of viscosities of different formulations are shown in Table 4 and rheology at different shear stress of finalized formulation F2 are shown in Table 5. On increasing shear stress viscosity was decreased so as we increase shear stress gel became thin so F_2fomulation shows rheological behavior.

Table 4: Viscosities of Formulations

Sr. No.	Formulation code	Viscosity in centipose
1.	F_1	69901
2.	**F_2**	**120521**
3.	F_3	113281
4.	F_4	94082
5.	F_5	101721
6.	F_6	79321
7.	F_7	99801
8.	F_8	85601

Table5: Rheology of Formulation (F_2)

Shear stress	Viscosity in centipose (F_2)
3	120521
6	109952
12	97785
30	83098
60	75435

Statistical analysis

The Similarity Factor (f_2) calculated for the finalized batch (F_2) in comparison to Tugain gel is summarized in Table 6 and Fig.1. f_2 value of finalized batch was more than 50 i.e. 54.68, indicating similar dissolution profile with Tugain gel.

Table 6: In vitro drug release % profiles comparison of Formulation batch (F_2) and Marketed formulation (Tugain Gel) by using similarity factor (f_2).

Time (hrs.)	Finalized batch (F_2)	Marketed formulation (Tugain gel)
0.5	1.51±0.78	2.34±1.23
1	7.23±1.19	12.23±1.45
2	14.12±1.2	22.12±0.98
3	19.21±1.3	30.76±1.67
4	26.35±1.3	35.76±1.67
5	31.02±1.2	48.15±1.09
6	45.15±1.3	58.56±1.34
7	58.3±1.35	72.45±1.56
8	75.96±1.2	95.34±0.97
9	82.21±1.9	-
10	93.24±1.5	-

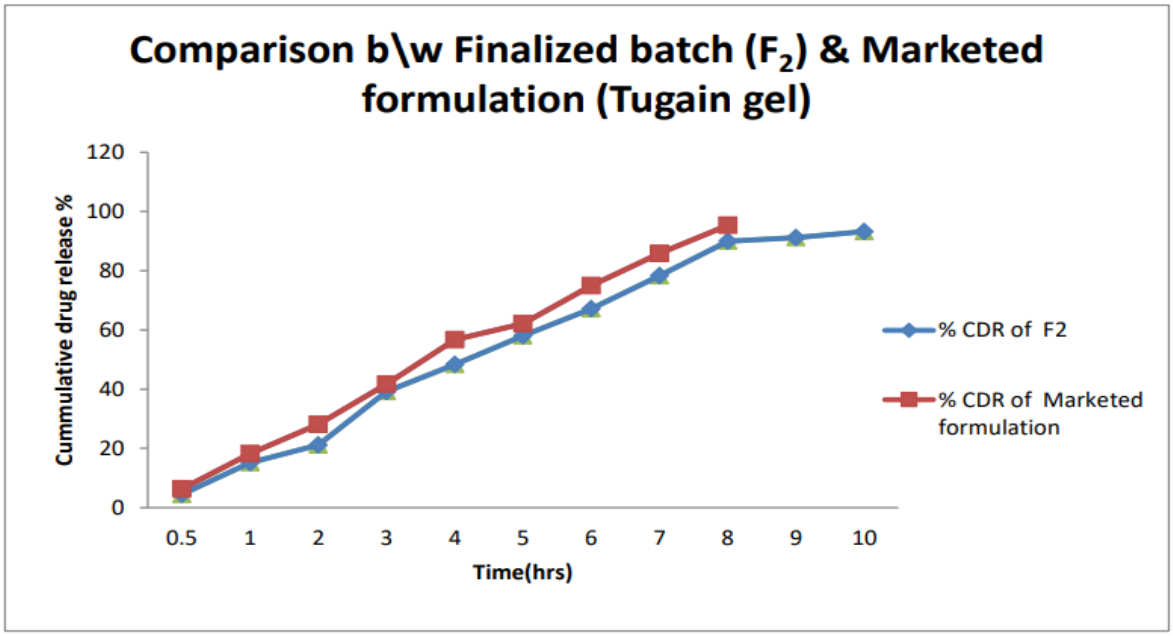

Fig 1. comparison of cumulative drug release % b/w finalized batch (F_2) and Marketed formulation (Tugain gel)

In vitro Drug Release Study

In vitro drug release study of eight batches (F_1-F_2) is summarized in Table 7 and in Figure 2.

Time (hrs.)	F1	F2	F3	F4	F5	F6	F7	F8
0.5	1.2±0.9	**1.51±0.78**	1.15±0.71	1.03±0.82	1.07±0.91	1.32±0.73	1.17± 0.67	1.12± 0.8
1	6.28±1.21	**7.23±1.19**	6.23±1.34	5.23±1.37	5.03±1.22	6.04±1.29	5.5± 1.33	5.97± 1.2
2	12.08±1.3	**14.12±1.2**	11.23±1.2	9.52±1.23	9.55±1.27	11.52±1.3	9.2±1.26	10.11±1.38
3	14.03±1.2	**19.21±1.3**	14.15±1.3	11.14±1.2	12.58±1.3	16.07±1.1	14.13±1.28	15.32±1.29
4	15.02±1.3	**26.35±1.3**	18.13±1.3	15.45±1.3	16.55±1.1	21.17±1.2	16.93±1.31	19.05±1.35
5	19.02±1.2	**31.02±1.2**	30.09±1.2	28.03±1.2	28.54±1.2	36..46±1.1	33.17±1.35	26.23±1.42
6	22.15±1.2	**45.15±1.3**	40.93±1.3	35.17±1.5	45.31±1.3	55.35±1.3	52.23±1.29	49.32±1.39
7	31.21±1.5	**58.3±1.35**	56.17±1.2	42.19±1.3	58.23±1.3	63.51±1.2	61.39±0.13	51.55±1.28
8	45.17±0.2	**75.96±1.2**	61.07±1.3	56.52±1.4	69.37±1.6	73.86±1.3	67.43±1.43	59.4±1.37
9	57.80±1.8	**82.21±1.9**	71.10±1.6	69.23±0.9	75.31±0.8	79.71±1.7	59.4±1.37	66.4±1.5
10	75.07±1.1	**93.24±1.5**	77.34±0.5	79.08±0.1	81.09±0.6	83.23±1.1	84.09±1.5	78.09±1.8

Table7 :*In vitro* drug release from gel formulations

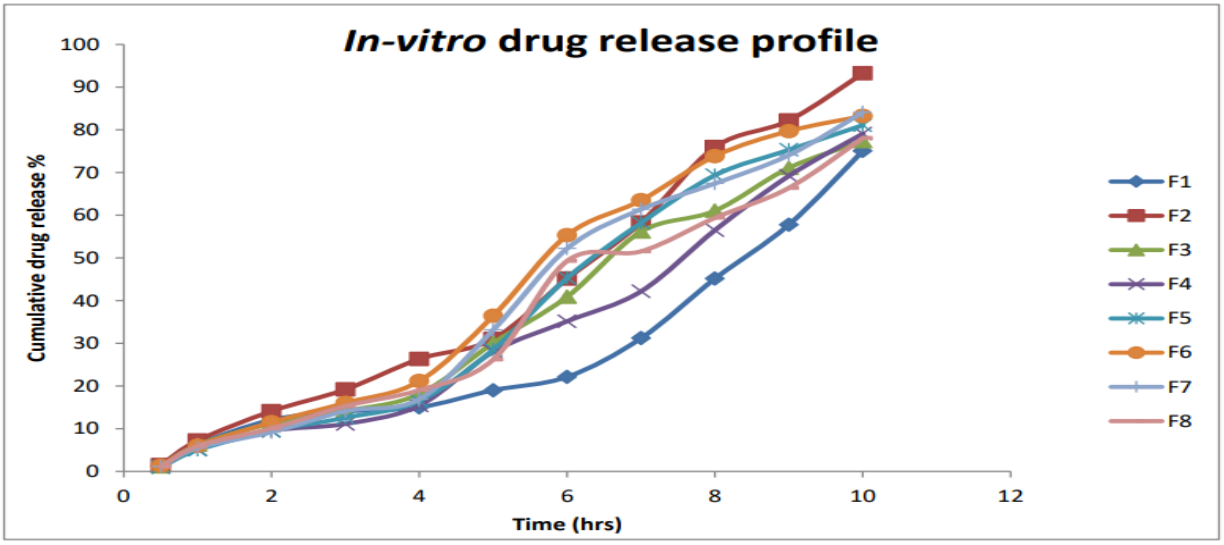

Figure 2: *In vitro* drug release profile of Minoxidil loaded Aloevera gel

Conclusion

The present study aimed to formulate and evaluate Minoxidil Loaded Aloe vera gel. The scheme of work has been divided into various parts. Initially, collection of theoretical and technical data by extensive literature reviewand then drug profile was done. Followed by procurement of materials and standardization of all materials used in the formulation and they meet Pharmacopeial and other established standards. Minoxidil Loaded Aloe vera gel was successfully formulated and evaluated by Homogenization method.

From this study it can be concluded that it is possible to design Minoxidil Loaded Aloe vera gel for the treatment of alopecia that have more moisturizing properties it is due to the presence of Aloe vera and it also impart the nutritional support to the system which indicate that the proposed Novel formulation can be excellent therapy for the treatment of alopecia with less side effects and better efficiency.

Future Scope

The potential clinical application of Minoxidil Loaded Aloe vera gel can be achieved in future so that one can obtain an optimal dosage regimen and clinical management of individual patient and therapeutical drug monitoring. The incorporation of natural ingredient like aloe vera gel showed better result in the fact that it minimizes the side effect associated with Minoxidil. So the Minoxidil loaded Aloe vera gel formulation has many advantages over marketed formulation. High efficacy and minimizing undesirable side effects of the present study may be utilized in future to produce Novel dosage forms.

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