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FABRICATION & ASSESSMENT OF HERBAL ALOE VERA MULTIPURPOSE GEL

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ABSTRACT
The objective of the study is to fabrication & assessment of herbal aloe vera multipurpose gel containing leaf extract of Aloe vera, Neem & Tulsi, for their anti-ageing &anti-septic activity in rats. 12 herbal gel formulations were prepared using 1.5% of gelling agents carbopol 934 (F1-F6) and carbopol 940 (F6-F12) and they were evaluated for physical appearance, net content, viscosity, extrudability, pH, spreadability, in vitro diffusion profile and primary skin irritation tests. The stability study for the topical herbal gel formulation was done for 3month at 25ºC±2 ºC/60%RH±5%RH, 32ºC±2 ºC/60%RH±5%RH, 40ºC±2 ºC/60% RH±5%RH and Assessment of microbial load were also carried out. Formulated gels were homogenous, stable and complied with the guidelines. Among the formulations, F4 showed better release (98.4 %) characteristics than other formulations. No erythema or edema was observed in the skin irritation test confirming the gel was non-toxic and safe.

KEYWORDS: Skin irritation, carbopol 934 & 940, spreadability, pH, ICH guidelines, skin disorder.

INTRODUCTION

Classification of gel formulations

The gel formulation has several key benefits over conventional semisolid dose formulations

1. Compared to other formulations, gels are simple to manufacture.
2. Gel is a sophisticated, non-greasy composition.
3. Gels offer fantastic adhesion to the application region.
4. Gels are eco-friendly and biocompatible.
5. Be incredibly resilient to stressful situations.

Disadvantages of gel formulation

Despite having a number of benefits. Gel formulations can come with certain drawbacks.

1. Gels have a more gradual and persistent effect.
2. The additives or gelators could irritate people.
3. The risk of microbial or fungal assault on gel is increased by the presence of water.
4. The formulation's solvent loss dries to gel.
5. In some gels, flocculation results in an unstable gel.

Ideal properties of topical gel

1. The gel taught to be uniform and transparent.
2. When shear or force is applied during the container's shaking, the gel should break easily.
3. The gel should have an inert composition.
4. The gel must not be sticky.
5. The gel shouldn't ever contact with another component in the formulation.
6. The gel must be reliable.
7. The skin or any area where the gel is placed shouldn't be irritated.
8. The gel should be inert in nature.
9. The gel should be non-sticky.
10. The gel should not interact with any other formulation component.
11. The gel should be stable.
12. It should be non-irritate to the skin or any part where the gel is applied.
13. The viscosity is should be optimum.
14. It should have anti- microbial activity.

Classification of gels

Gels can be classified based on colloidal phases, nature of solvent used, physical nature and rheological properties.

Based on colloidal phases they are classified into:

a. Inorganic (Two phase system)
b. Organic (Single phase system)

Inorganic (Two-Phase System): The system consist of floccules of tiny particles rather than larger molecules and the gel structure will be unstable if the dispersed phase partition size is especially large and develops a three imensional structure throughout the gel. They must be thixotropic, which means that when disturbed, they

transform from a semisolid to a liquid. eg.aluminium hydroxide and bentonite magma gel.

Organic (Single Phase System): On the twisted threads, there are large organic molecules that are continuously dissolved. The majority of organic gels are single-phase solutions made up of organic liquids such Plastic base and gelling agents like carbomer and tragacanthin.

Based on Nature of the Solvent Hydrogels: (water based): A hydrogel is three-dimensional networks of hydrophilic polymers that can grows in water and contain a significant quantity of water while maintaining their structural integrity due to the chemical or physical cross-linking of individual polymer chains. Hydrophilic colloids like silica, bentonite, tragacanth, pectin, sodium alginate, etc. provide an example. The hydrogel may be utilized as an ECG medical electrode, rectal medication delivery system, and SR drug delivery system.

Organogel: (With a non-aqueous solvent):A liquid organic phase is contained within a three dimensional, cross-linked network in an organogel, a type of gel. The addition of a polar solvent causes the organo gelling or gelation of lecithin solution in organic solvents.

Xerogels: Xerogels are solid-formed gels created by allowing materials to gently dry at room temperature while experiencing unrestricted shrinking. Viscous sintering takes place when xerogel is heated over a certain point, thereby turning the porous gel into a thick glass. Examples include polystyrene, dry cellulose, and tragacanth ribbons. Gels categorized as plastic, pseudo-plastic, and thixotropic because they display non-Newtonian flow.

Based on Physical Nature Elastic gels: Agar, pectin, Guar gum, and alginates gels have an elastic property. At the point of junction, the fibrous molecules are joined by comparably weak connections such as hydrogen bonds and dipole attraction. If the molecule has a free –COOH group, a salt bridge of the type -COO-X-COO forms an extra bond between two adjacent strand networks. e.g.: Alginate and Carbopol.

Rigid gels: This can be made from macromolecules with primary valence bonds connecting the framework. e.g. Silic acid molecules are kept together in a silica gel by the Si-O-Si-O link.

Plant profile

Plant Name	Family	Chemical Constituents	Part Used	Plant Picture
Aloe vera	Liliaceae	Aloin, Aloe-Emodin	Leaves	
Neem (Azadirachtaindica)	Meliaceae	Azadirachtin, Nimbin, Nimbudin, Myricetin	Leaves	
Tulsi (Ocimum sanctum)	Lamiaceae	Eugenol, Linalool, α-Pinene, Luteolin, Orientin	Leaves	

MATERIAL AND METHOD

The mature fresh leaves of Aloe vera, Neem & Tulsi were collected from Balaghat (M.P.), and authenticated by Botanist of Govt. JST College, Balaghat. triethanolamine, propylene glycol and disodium edetate were purchased from vendor Sigma-Aldrich. Carbopol 934 and carbopol 940 were obtained from LobaChemie Pvt. Ltd. Mumbai.

Preparation of extracts: The leaves of Aloe vera, Neem & Tulsi were processed to remove earthy matter and residual materials carefully from the leaves, then cleaned and shade dried. Gel of aloe vera were collected by peel off & scoup out gel than extracted in a Soxhlet extractor with ethanol for 72 h. Coarse powdered leaves of Neem & Tulsi was extracted with ethanol by cold maceration process for 7 days. Both the extracts were then filtered and concentrated under reduced pressure in IKA Rotary evaporator (Model No RN 10 digital V, ILMAC Germany) at 40 °C and stored at 4-8 °C for further use.

Preparation of gel base: Carbopol 934 was dissolved slowly with stirring in 60 mL of demineralized water for 1 h to avoid agglomeration. Then disodium edetate and triethanolamine were dissolved in 10 mL of demineralized water separately and stirred for 10 min. Mixed 4.83 mL of propylene glycol in 12 mL of demineralized water with stirring for 10 min. Disodium edetate and triethanolamine solution were added to carbopol solution and the pH was then adjusted to 7.4 by stirring the solution for 10 min. Then propylene glycol

solution was added with stirring for 10 min until a clear consistent gel base was obtained.

Preparation of gel formulation: 12 topical gel formulation was prepared using AVEE (ethanol leaf extract of aloevera) and NTEE (ethanol leaf extract of neem & tulsi) as per drug formulation manual where F1 to F6 formulations were made using the gel base of carbopol 934 (1.5 %) and F7 to F12 formulations were made using the gel base of carbopol 940 (1.5 %). Details of formulation compositions are recorded inTable1. The F4 formulation prepared using carbopol 934 was evaluated for anti-arthritic activity as it exhibited better quality characteristics.

Table 1: Gel formulations with carbopol 934 and carbopol 940.

Formulation gel code	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
Aloe vera extract (g)	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
Neem extract (g)	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
Tulsi extract (g)	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
Carbopol 934 (g)	1.5	1.5	1.5	1.5	1.5	1.5	--	--	--	--	--	--
Carbopol 940 (g)	--	--	--	--	--	--	1.5	1.5	1.5	1.5	1.5	1.5
Triethanol amine (g)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Disodium EDTA (g)	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Propylene Glycol (g)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
D.M. water (100 g)	q.s	q.s	q.s	q.s	q.s	q.s	q.s	q.s	q.s	q.s	q.s	q.s

EVALUATION OF TOPICAL HERBAL GEL FORMULATION

Estimation of active constituents in gel formulation (net content): Each formulation (1 g) was taken in a 50 mL volumetric flask and made up to volume with ethanol and shaken well to dissolve the active constituents in ethanol. The solution was filtered through Whatman filter paper and 0.1 mL of the filtrate was pipetted out and diluted to 10 mL with ethanol. The content of active constituents was estimated spectrophotometrically by using standard curve plotted at 280 nm (λmax of active constituents in the extracts).

Extrudability: A closed collapsible tube containing about 20 g of gel was pressed firmly at the crimped end and a clamp was applied to prevent any roll back. The cap was removed and the gel was extruded. The amount of the extruded gel was collected and weighed. The percentage of the extruded gel was calculated (Nappinai, Pakalapati, Arimilli, 2006).

pH measurement: pH measurement of the gel was carried out using a digital pH meter by dipping the glass electrode completely into the gel system to cover the electrode. The measurement was carried out in triplicate and the average of the three readings was recorded (Queiroz et al., 2009).

Appearance and Homogeneity: Physical appearance and homogeneity of the prepared gels were evaluated by visual perception.

Viscosity: Viscosity of gel was determined using Brookfield viscometer (S-62, model LVDV-E) at 25 °C with a spindle speed of the viscometer rotated at 12 rpm (Nayak et al., 2005).

Spreadability: Two sets of glass slides of standard dimensions were taken. The herbal gel formulation was placed over one of the slides. The other slide was placed on the top of the gel, such that the gel was sandwiched between the two slides in an area occupied by a distance of 7.5 cm along the slides. Hundred g weight of gel was placed on the upper slides so that the gel was between the two slides was pressed uniformly to form a thin layer. The weight was removed and the excess of gel adhering to the slides was scrapped off. The two slides in position were fixed to a stand without slightest disturbance and in such a way that only upper slides to slip off freely by the force of weight tied on it. A 20 g weight was tied to the upper slide carefully. The time taken for the upper slide to travel the distance of 7.5 cm and separated away from the lower slide under the influence of the weight was noted. The experiment was repeated for three times and the mean time was taken for calculation. (Jain et al., 2007).

Spreadability was calculated by using the following formula: $S = m \times l/t$

where, S= spreadability, m-weight tied to upper slides (20 g), l- length of the glass slide (7.5 cm), t- time taken in sec.

In vitro diffusion profile (In vitro permeation in rat skin): In vitro diffusion studies for all formulations were carried out using Franz diffusion cell. The diffusion cell apparatus was fabricated locally as open-ended cylindrical tube with 3.7994 cm2 area and 100 mm height having a diffusion area of 3.8 cm2. Phosphate buffer (pH 7.4) was used as receptor media. Rat abdominal skin was used as dialysis membrane. The skin was tied to the diffusion cell (donor cell) such that the stratum corneum side of the skin was in intimate contact with the release surface of the formulation in the donor cell. Isotonic phosphate buffer solution, pH 7.4 (100 mL) was added to a donor compartment prior to be mounted on the diffusion cell. A weighed quantity of formulation equivalent to 1 g of gel was taken on to the rat skin and was immersed slightly in 100 mL of receptor medium, which was continuously stirred. The entire system was

maintained at 37±1 ºC. An aliquot of 5 mL was withdrawn at specific time intervals up to 8 h, and was estimated spectrophotometrically at 275 nm. After each withdrawal, the diffusion medium was replaced with an equal volume of fresh diffusion medium. The cumulative percent release was calculated for each time (in h) interval.

Release kinetics: To find out the release pattern of active constituent from herbal gel, data obtained were fitted to different mathematical models (Martin, 1994). Zero order kinetics is a concentration independent kinetics and first order kinetics is the dependent kinetics, where drug release may follow swelling and erosion or simply diffusion. Data were validated using Higuchi's model to ascertain the reaction.

Stability studies of topical herbal gel formulation: The main objective of the stability testing is to provide evidence on how the quality of the drug product varies with time under the influence of temperature and humidity. The stability study for the topical herbal gel formulation was done as per ICH guidelines in a stability chamber for a period of 3 months. The selected topical herbal gel formulation consisting of 2% of each AVEE and NTEE was loaded in a humidity chamber (Floor standing model, 3 units in one with individual humidity and temperature controller, 300 X 300 X 300 mm, 15-60°C, Technico, India) at 25°C ± 2°C/60% RH ± 5% RH, 32°C ± 2°C/60% RH ± 5% RH and 40°C ± 2°C/75% RH ± 5% RH. Samples were withdrawn at an initial, first, second, third and three months and evaluated for change in color, odor, homogeneity, pH, viscosity, net content, microbial load and sterility test.

Skin irritation study: Three young adult rabbits were housed in metal cages fitted with perforated floors. Water and standard rabbit feed were given ad libitum. The room temperature was maintained at 22 ± 3 °C with 30 - 70 % relative humidity. The light conditions were controlled to give 12 h artificial light (8 am - 8 pm) each day. Twenty four h before the test (dose application), hair on the back and flanks of each rabbit were shaved cleanly, exposing approximately 6 cm2 area of skin. The final gel formulation was evenly applied to 4 cm^2 area of the closely clipped skin of each rabbit. Skin reaction at the site of application was subjectively assessed and scored once daily at 1, 24, 48, 72 h, 7 and 10 days (posttest observation period) accordingly.

RESULTS AND DISCUSSION

In general, gel formulation is more preferred, among the other topical semisolid preparations, since it has long residence time on the skin, high viscosity, moisturizing effect on flaky skin due to their occlusive properties, more bio adhesiveness, less irritation, independent of water solubility of active ingredient, ease of application and better release characters (Loganathan et al., 2001). Aloin is responsible for Aloe vera's laxative and anti-inflammatory properties. Aloe-emodin has antimicrobial, anticancer properties. Azadirachtin, nimbin, nimbudin have Antibacterial properties while Myricetin responsible for Anti-aging & skin protection. Olic acid provide Moisturizing & healing skin. Eugenol present in tulsi responsible for antiseptic & antioxidant properties.

Many studies have indicated that flavonoids such as Myricetin, luteolin and apigenin in herbs possess anti-inflammatory and anti-arthritic activity. Further, these polyphenolic flavonoids, apigenin and luteolin reported that they can penetrate the human skin (Giinter et al., 2008) and hence a topical herbal gel formulation was designed containing these flavonoids for the treatment of inflammation also.

- Twelve different gel formulations (F1 to F12) were prepared using different concentrations (0.5, 1, 1.5, 2, 2.5 and 3% w/w) of ethanol extract of aloevera, neem and tulsi, with 1.5 % concentration of Carbopol 934 or Carbopol 940 polymer respectively.
- Carbopol 934 and carbopol 940 were used as gelling agent in the formulation as they are biodegradable, bioadhesive, biocompatible, irritation free and not absorbed into body.
- Among the two polymers used, carbopol 934 was reported to have more gelling property than carbopol 940 (Blonco-Flonte et al., 1996), which is in correlation with our study. Carbopol 934 polymer proved to be a promising carrier for controlled release of active phytoconstiuents in the gel formulation.
- The percentage of polymer was optimized after preparing the gel with various concentrations from 0.5 to 2.5%, where the 1.5 % of carbopol (934 or 940) containing gels was found to be compatible with the requirements of gel formulations.
- From the quality control test, it was apparent that the gel formulations prepared with Carbopol 934 (F1 to F6) as a gelling agent were found to be superior to the gel formulations prepared with Carbopol 940 (F7 to F12) except only spreadability parameters where Carbopol 940 was found to be good. Hence the in vitro diffusion studies were carried out only for the six herbal topical gel preparations F1 to F6, formulated using carbopol 934 and the in vitro release and stability studies were carried out for the best herbal gel formulation F4.
- Twelve gel formulations F1 to F12 prepared using carbopol polymers were evaluated for physical appearance, pH, viscosity, spreadability, net content, extrudability and in vitro diffusion profile. Results of the study were in acceptable limits of the ICH guidelines and the details of the same are recorded in Table 2.

Table 2: Evaluation parameters for topical herbal gel formulation made with 1.5% Carbopol 934.

Formulation code	F1	F2	F3	F4	F5	F6
Conc (%)	0.5	1.0	1.5	2..0	2.5	3.0
pH*	7.50	7.56	7.76	7.60	7.85	7.41
Viscosity* (poise)	0.3850	0.3863	0.3871	0.3884	0.3891	0.3910
Spreadability* g cm/sec	32.19	45.05	56.39	64.00	71.38	75.74
Net content* % w/w	99.7	105	105	105	101	101
Extrudability*	Good	Excellent	Good	Excellent	Excellent	Excellent
Physical appearance	Greenish, smooth and translucent	Dark green, smooth, homogenous, translucent	Dark green, smooth, homogenous, translucent	Dark green, smooth, homogenous, translucent	Dark green, smooth, homogenous, translucent	Dark green, smooth, homogenous, translucent

- Dimethylsulfoxide and propylene glycol are reported to be the two best permeation enhancers (Panigrahi et al., 2006). Since DMSO reported to causes skin erosion we have used propylene glycol as permeation enhancer in the preparation of the gel formulation (Walker, Smith, 1996). Disodium edetate and triethanolamine were used in the formulation in order to adjust the pH of the formulation.
- Prepared gels were found to be homogeneous and in good appearance and consistency. The pH values of all the formulations were in the close range of neutral pH (7.41-7.88) and hence it caused no skin irritation, which is also supported by skin irritation study.
- Polymers were included in the designed topical formulations in order to provide a prompt release of drug and to achieve as well as to maintain the drug concentration within the therapeutically effective range. As the concentration of the polymer was fixed as 1.5% in all the gel formulations no variation in viscosity was observed. Further the value between 0.385 and 0.391 poise was reported to be an ideal viscosity value for topical gel formulation developed using carbopol polymers (Kim et al., 2003).
- Values of the spreadability indicated that the gel formulations are easily spreadable. Among the gel formulations F1 to F6, more than 90% of the contents were extrudable indicating they have excellent extrudability except F1 and F3 as 80% of the contents were extrudable (>90% extrudability: excellent, >80% extrudability: good, >70% extrudability: fair).

In vitro diffusion profile and release kinetics: In vitro diffusion profile of F1 to F6 formulations are recorded in Figure1. Since the pH of membrane used was in the range of 5 to 7.8, phosphate buffer saline pH 7.4 was used for the in vitro release studies of the gel formulations. The in-vitro release profiles of all the six formulations made using carbopol 934 elicited almost 100 % release from the formulation within 5 h.

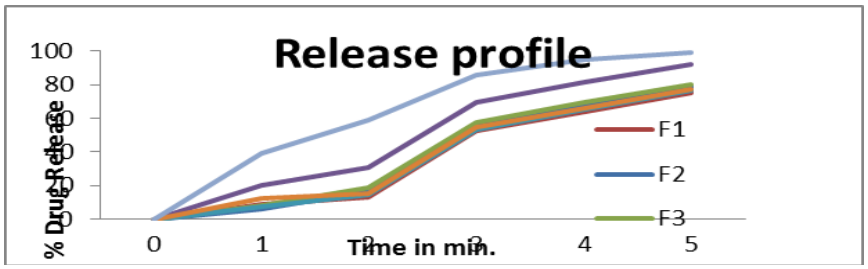

Figure 1: In vitrodiffusion profile of topical herbal gels (F1-F6) and diclofenac sodium gel.

The in vitro release characteristics of the prepared topical herbal gel formulations were quite encouraging and in agreement with marketed aloeveragel. Among the formulations, F4 showed better release (92.4 %) characteristics than F1, F2, F3, F5 and F6 (Figure2 to 4).

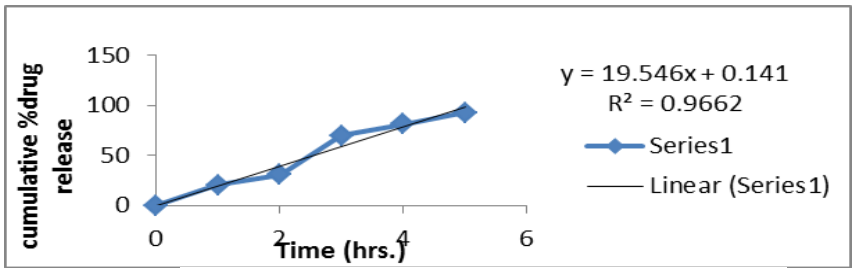

Figure 2: Zero order plot for F4 topical herbal gel formulation.

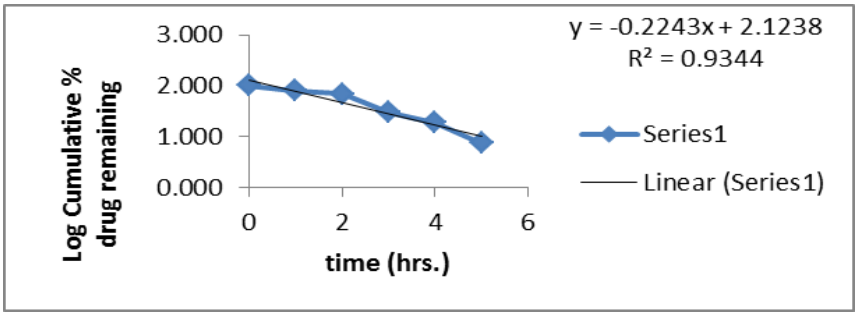

Figure 3: First order plot for F4 topical herbal gel formulation.

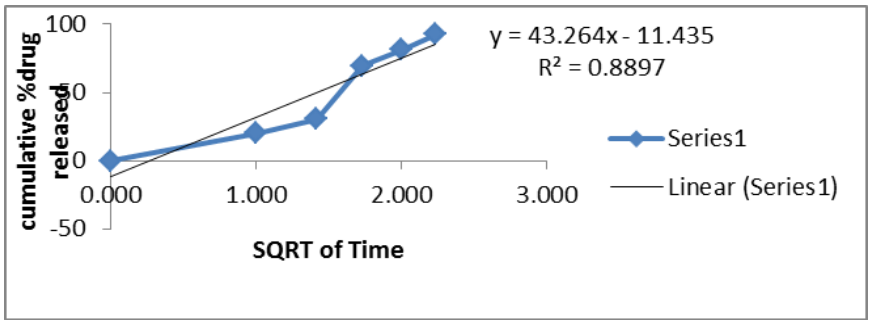

Figure 4: Higuchi diffusion plot for F4 topical herbal gel formulation.

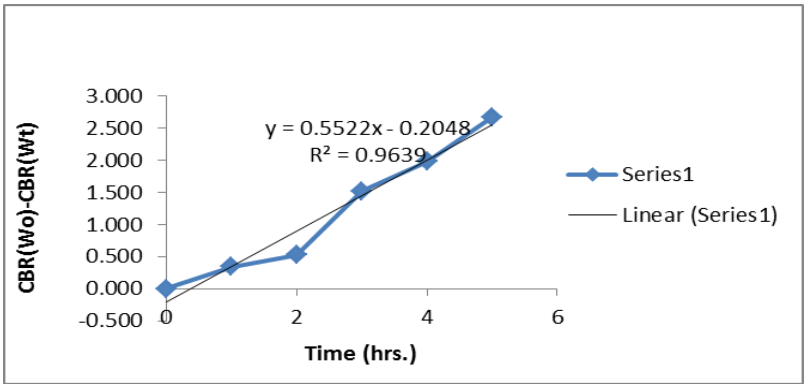

Figure 5: Hixon plot for F4 topical herbal gel formulation.
Figure 6: korsmeyer plot for F4 topical herbal gel formulation.

Based on our kinetic release study, we observed that the F4 formulation followed zero order kinetics. Commercial aloevera gel formulation released almost 95% of its content within 3 h, whereas F4 formulation consisting of 2% each of AVEE and NTEE prolonged its release of active constituents up to 5 h (almost 100%), making it suitable for sustained release and for better patient compliance. Thus from the release data observed using different mathematical models, gel formulation containing 2% of each of AVEE and NTEE showed zero order release kinetics (Table3).

Table 3: In vitro release kinetic study of topical herbal gel formulated with Carbopol 934.

Formulation code	Zero order R^2	First Order R^2	Higuchi diffusion model R^2	Hixon	Korsmeyer	Best fitted model
F1	0.9374	0.9299	0.7963	0.9374	0.9190	Zero order
F2	0.9434	0.9351	0.8031	0.9426	0.9425	Zero order
F3	0.9490	0.9383	0.8172	0.9474	0.9444	Zero order
F4	0.9662	0.9344	0.8897	0.9639	0.9390	Zero order
F5	0.9397	0.9319	0.7964	0.9386	0.9305	Zero order
F6	0.9428	0.9335	0.8152	0.9413	0.9150	Zero order

Skin irritation test: The prepared herbal gel was evaluated for its skin irritant effect, where no erythema or edema was observed for all the formulations (Table4), even after 10 days of study, indicating that the prepared herbal gel formulation was found to be safe.

Table 4: Primary skin irritation test for herbal gel formulation.

	Rabbit Numbers			Rabbit		Combined index
	1	2	3	Control	Average	
1 h						
Erythema Score	0	0	0	0	0.00	0.00
Edema Score	0	0	0	0	0.00	
24 h						
Erythema Score	0	0	0	0	0.00	0.00
Edema Score	0	0	0	0	0.00	
48 h						
Erythema Score	0	0	0	0	0.00	0.00
Edema Score	0	0	0	0	0.00	
72 h						
Erythema Score	0	0	0	0	0.00	0.00
Edema Score	0	0	0	0	0.00	
7 days						
Erythema Score	0	0	0	0	0.00	0.00
Edema Score		0	0	0	0	0.00
10 days						
Erythema Score	0	0	0	0	0.00	0.00
Edema Score	0	0	0	0.00		

Stability testing: In order to ensure the quality, safety and efficacy throughout the shelf life, stability study was performed as per ICH guidelines for F4 formulation (prepared using carbopol 934) as it exhibited better quality characteristics. No change in color, odour, homogeneity, pH, viscosity and net content of the topical herbal gel formulation was observed for this formulation after 0, 1, 2 and 3 months of stability testing. Results of the study clearly revealed that the formulated topical gel F4 is found to be stable (Table5).

Table 5: Stability studies of topical herbal gel formulation.

F4 containing 2% w/v/ of each AVEE and NTEE													
S. No.	Parameters	Storage condition											
		25ºC±2 ºC/60%RH±5%RH				32ºC±2 ºC/60%RH±5%RH				40ºC±2 ºC/60%RH±5%RH			
		Months				Months				Months			
		0	1	2	3	0	1	2	3	0	1	2	3
1	Color	No change in color				No change in color				No change in color			
2	Odour	No change in odour				No change in odour				No change in odour			
3	Homogeneity	Smooth				Smooth				Smooth			
4	pH	6.41	6.43	6.49	6.36	6.43	6.40	6.41	6.38	6.42	6.40	6.37	6.35
5	Viscosity (poice)	0.381	0.383	0.379	0.374	0.382	0.383	0.380	0.376	0.384	0.380	0.378	0.371
6	Net Content (%)	99	99	98	97	99	98	98	97	99	97	96	95
7	Microbial Load (Bacteria & Fungi)	No microbial growth was found at 24, 48 &72 hrs.				No microbial growth was found at 24, 48 &72 hrs.				No microbial growth was foundat 24, 48 &72 hrs.			
8	Sterility test	No microbial growth was found at 24, 48 &72 hrs.				No microbial growth was found at 24, 48 &72 hrs.				No microbial growth was foundat 24, 48 & 72 hrs.			

CONCLUSION

Aloe-emodin has antimicrobial, anticancer properties. Azadirachtin, nimbin, nimbudin have Antibacterial properties while Myricetin responsible for Anti-aging & skin protection. Olic acid provide moisturizing & healing skin. Eugenol present in tulsi responsible for antiseptic & antioxidant properties. Many studies have indicated that flavonoids such as Myricetin, luteolin and apigenin in herbs possess anti-inflammatory and anti-inflamatory activity. The developed formulation F4 consisting 2% each of AVEE and NTEE with 1.5% of carbopol 934 was found to be promising topical herbal gel for the moisturization & healing skin. Further clinical studies can strengthen the use of this formulation for the patients suffering from other skin problem.

REFERENCE

1. Ashok AmolAbuj, Formulation and Evaluation of Alovevera Gel. International Journal of Novel Research and Development (IJNRD) ISSN: 2456-4184.
2. Tikariya, K., Gawshinde, A., Dabeer, A., Mishra, S., Atneriya, U. K., & Solanki, D. (2023). Formulation and evaluation of herbal hand wash using neem and aloevera extract. Indian Journal of Pharmacy and Pharmacology, 10(2): 89–93.

3. JEYADEVI, R.; SIVASUDHA, T.; RAMESH KUMAR, A.; DINESH KUMAR, L. Anti-arthritic activity of the Indian leafy vegetable Cardio sperm umhalicacabum in Wistar rats and UPLC-QTOF-MS/MS identification of the putative active phenolic components. Inflamm. Res., 2013; 62(1): 115-26.
4. KIM, J.Y.; SONG, J.Y.; LEE, E.J.; PARK, S.K. Rheological properties and microstructures of carbopol gel network system. Colloid Polym. Sci., 2003; 281(7): 614-623.
5. KUMAR, E.; MASTAN, S.K.; AMRANDER REDDY, G.; RAGUNANDAN, N.; SREEKANTH, N.; CHAITANYA, G. Anti-arthritic property of the ethanolic leaf extracts of Cardiospermumhalicacabum Linn. Biomed. Pharmacol. J., 2008; 2(1).
6. KUMARAN, A.; KARUNAKARAN, R.J. Antioxidant activities of the methanol extract of Cardiospermumhalicacabum. Pharm. Biol., 2006; 44(2): 146-151.
7. LAIRD, J.M.A.; CARTER, A.J.; GRAUERT, M.; CERVERO F. Analgesic activity of a novel use-dependent sodium channel blocker, crobenetine, immuno-arthritic rats, Br. J. Pharmacol., 2001; 134(8): 1742-1748.
8. LOGANATHAN, V.; MANIMARAN, S.; JASWANTH, A.; SULAIMAN, A.; SHIVAPRASADHA, R.M.V.; SENTHIL KUMAR, B.; RAJASEKARAN, A. The effects of polymers and permeation enhancers on releases of flurbiprofen from gel formulations. Indian J. Pharm. Sci., 2001; 63(3): 200-204.
9. MARTIN, A. Physical pharmacy, kinetics. First Indian reprint. New Delhi: B.I Waverly, 1994.
10. MIZUSHIMA, Y.; TSUKADA, W.; AKIMOTO, T. A Modification of rat adjuvant arthritis for testing anti-rheumatic drugs. J. Pharm. Pharmacol., 1974; 24(10): 781-785.
11. MURPHY, C.T.; MCCARROLL S.A.; BARGMANN, C.I.; FRASER, A.; KAMATH, R.S.; Genes that act downstream of DAF-16 to influence the lifespan of Caenorhabditiselegans. Nature, 2003; 424: 277-283.
12. NAIR, A.M.; SARAF, M.N. Inhibition of antigen and compound 48/80 induced contraction of guinea pig trachea by ethanolic extract of the leaves of Vitexnegundolinn. Indian J. Pharmacol., 1995; 27(4): 230-233.
13. ASHA, V.V.; PUSHPANGADAN, P. Anti-pyretic activity of Cardiospermumhalicacabum. Indian J. Exp. Biol., 1999; 37(4): 411-414.
14. BABU, K.C.V.; KRISHNAKUMARI, S. Cardiospermumhalicacabum suppresses the production of TNF-α and NO by human peripheral blood mononuclear cells. Afr. J. Biomed. Res., 2006; 6: 95-99.
15. BLONCO-FLONTE, H.; ANGUIANO-IGEA S.; OTERO-ESPINAR, F.J.; BLANCOMENDEZ, J. In-vitro bioadhesion of carbopol hydrogel. Int. J. Pharm., 1996; 142: 169-174.
16. CHOI, E.M.; LEE, Y.S. Luteolin suppresses IL-1b-induced cytokines and MMPs production via p38 MAPK, JNK, NF-kappaB and AP-1 activation in human synovial sarcoma cell line, SW982. Food Chem. Toxicol., 2010; 48(10): 2607- 2611.
17. FELDMANN, M.; MAINI, S.R. Role of cytokines in rheumatoid arthritis: an education in pathophysiology and therapeutics. Immunol. Rev., 2008; 223; 7-19.
18. GHOSH, M.N. Fundamentals of experimental pharmacology. Kolkatta: Scientific Book Agency, 1984; 156-157.
19. GIINTER, S.; IRMARGD, M.; UTE, W.; CHISTOPH, M.S. Anticarcinogenic effects of the flavonoid luteolin. Molecules., 2008; 13(10): 2628-2651.
20. GOPALAKRISHNAN, C.; DHANANJAYAN, R.; KAMESWARAN, L. Studies on the pharmacological actions of Cardio sperm umhalicacabum. Indian J. Physiol. Pharmacol., 1976; 20: 203-206.
21. GUPTA, M.; MAZUMDER, U.K.; BHAWAL, S.R. CNS activity of Vitexnegundo Linn in mice. Indian J. Exp. Biol., 1999; 37(2): 143-146.
22. JAIN, S.; PADSALG, B.D.; PATEL, A.K.; MOALE, V. Formulation development and evaluation of fluconazole gel in various polymer bases. Asian J. Pharm., 2007; 1: 63-68.
23. Saleem Aisha, et al., (2022). Aloe Vera Gel Effect on Skin and Pharmacological Properties. Scholars International Journal of Anatomy and Physiology. ISSN., 2616-8618.
24. Kalyan, AnujaKamble, et al., (2023). Formulation and Evaluation of Aloe Vera Gel.
25. Saleem, A., Naureen, I., Naeem, M., Murad, H. S., Maqsood, S., & Tasleem, G. (2022). Aloe vera gel effect on skin and pharmacological properties. Scholars International Journal of Anatomy and Physiology, 5(1): 1–8. https://doi.org/10.36348/sijap.2022.v05i01.001.
26. TULSI MIRACLE IN AYURVEDA: a REVIEW. (2024). In International Journal of Medico-Dental Innovations (Vol. 2, Issue 1). https://ijmdi.com/papers2-1/IJMDI-V2-1-paper2-Tulsi%20Miracle%20In%20Ayurveda-%20A%20Review.pdf.
27. Ali, J., Khan, A., Kotta, S., Ansari, S., Sharma, R., & Kumar, A. (2013). Formulation development, optimization and evaluation of aloe vera gel for wound healing. Pharmacognosy Magazine, 9(36): 6. https://doi.org/10.4103/0973-1296.117849.