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Formulation and Evaluation of Herbal Gel Using Acalypha indica Extract for Potential Dermatological Applications

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ABSTRACT

The present research aimed to develop and evaluate an herbal gel formulation utilizing Acalypha indica extract for potential dermatological applications. Acalypha indica, a widely recognized medicinal plant with various pharmacological properties, was chosen for its known anti-inflammatory, antioxidant, and wound healing effects. The gel formulation was developed using suitable gelling agents and evaluated for its physical characteristics, stability, and in vitro skin permeation studies. The herbal gel's efficacy was assessed for its potential use in dermatological conditions such as wound healing, inflammation, and skin rejuvenation.

KEY WORDS:

Acalypha Indica, Herbal Gel, Dermatological Applications, Formulation, Evaluation, Skin permeation.

1. INTRODUCTION:

Acalypha is the fourth largest genus of the Euphorbiaceae family, comprising 450 species. It includes green shrubs, trees, and annuals, primarily found in tropical regions of Africa, America, and Asia [Seebaluck et al., 2015]. Many Acalypha species are utilized for their medicinal properties, serving as remedies for ailments like stomachaches, dyspepsia, venom antidotes, rheumatism, and dermatitis. Additionally, the leaf infusion is utilized for treating stomach issues and body swellings, while the leaf maceration is used for eye infections, and its decoction is ingested in Tanzania to manage epilepsy. The plant holds various biological benefits related to its antioxidant, anti-inflammatory, wound healing, and cytotoxic properties [Ghuman *et al*.,2019]. Indian Copperleaf is a small upright herb, reaching heights of up to 60 cm or more. The ascending branches are angular and velvety hairy. The leaves are broadly ovate, almost triangular, and quite coarsely toothed. Leaf stalks are as long as or longer than the 3-5 cm long blades.

The plants belong to kingdom Plantae, subkingdom Tracheobionta, super division Spermatophyta, division Magnoliophyta, dicotyledons, order Euphorbiales, family Euphorbiaceae [Ojediran *et al*., 2024]. An ethanolic extract was prepared and subjected to anti-inflammatory activity. The obtained extract was formulated into a gel for evaluation tests [Charde *et al*.,2010]. The leaves are alternate, ovate, rhomboid-ovate, sometimes obovate, subacute or obtuse at the apex, cuneate or tapering at the base, serrate only in the upper part along the margins, dark green above, pale green below, glabrous or thinly hairy, with petioles 3-8 cm long and hairy stipules [Buwalda, 1948]. The leaf extract was utilized for treating scabies and other skin infections [Akram *et al*., 2020]. It is also beneficial for bronchitis and pneumonia. Gels are semi-solid preparations intended for external use [Bharat *et al*.,2011].

The sustained acalyphamide gel contains anti-inflammatory, anti-diabetic, analgesic, and cytotoxic properties [Prasad *et al*., 2021]. The aim is to enhance the anti-inflammatory activity of acalyphamide in acalypha indica through an extraction process using various solvents (ether, chloroform, water, hydro-ethanolic). Clinical trials

on rats, approved by the CPCSEA board [Pereira *et al*.,2004], demonstrate that the ethanolic extract of acalyphamide exhibits more potent effects compared to indomethacin and prednisolone, which are used as standards. Acalypha indica, commonly known as Indian Copperleaf, is a medicinal plant traditionally used in various cultures for its therapeutic properties. The plant is rich in bioactive compounds such as flavonoids, alkaloids, and phenolic compounds, which contribute to its pharmacological activities [Saboon *et al*., 2019]. The use of herbal extracts like Acalypha indica in topical formulations offers a natural and potentially safer alternative for treating skin conditions compared to synthetic products [Ibezim,2012]. This study focused on formulating a herbal gel incorporating Acalypha indica extract for dermatological applications.

2. MATERIALS AND METHODS:

- Collection and extraction of Acalypha indica extract using suitable solvents
- Formulation of herbal gel incorporating the extract with gelling agents and preservatives
- Evaluation of the gel formulation for physical characteristics (appearance, pH, viscosity)
- Stability testing under various storage conditions
- In vitro skin permeation studies using Franz diffusion cell technique

2.1. Plant material Collection:

Dried leaves of Acalypha indica authenticated by botanical survey by Prof. VS. Raju (Rtd. Prof. of Kakatiya university department of Botany Kakatiya University Warangal). The specimen voucher departed in the department of pharmacognosy in Vaagdevi pharmacy College Mariapuram, Bollikunta (near college premises). All the chemicals used were in analytical grade. Leaves of *Acalypha Indica* were taken and airdried for 3days and blended as powder.

2.2. Preparation of Extract:

It is done by Soxhlet apparatus and weigh the required amount of the powdered drug ad fixes it into the apparatus and start the process. Maintain the temperature at 5570℃ for about one day and flow of water is to be checked periodically. Note that bumping of solvent is avoided and for that maintain the temperature. Solvents used are chloroform and water. Every solvent is treated for 24hrs. The obtained extract was kept in desiccators to remove moisture and stored properly until use. It was shown in Fig.1

Fig 1: Extraction of Acalypha indica by Soxhlet apparatus

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2.3. Method of preparation of herbal gel:

Weigh accurately 1grm Carbopol and dissolved in100mlof water then it is mixed using magnetic stirrer for 30min continuously. Add 10ml of glycerin. Add two drops of triethanolamine, and finally add 0.5g of methyl paraben and propylparaben and their complete quantity were disclosed in Table.1.

Table 1: Method of preparation of Herbal gel

Excipients	F1	F2	F3
Methyl Paraben IP	0.5g	0.5g	0.5g
Propylparaben IP	0.5g	0.5g	0.5g
Carbopol934p	1.5g	1.2g	1.35g
Glycerin IP	27.5ml	22.8ml	21.65ml
Purified water	70ml	70ml	70ml
Dry extract of Acalypha indica	-	100mg	200mg

2.4. Evaluation of *Acalypha Indica* herbal complex:

2.4.1. Microscopic view:

Optical microscopy was used for knowing of the gel and the gel was observed at10X magnification.

2.4.2. Determination of λ-max:

The stock solution was prepared bydissolving10ml of *AcalyphaIndica*extractin100ml of pH 7.2 phosphate buffer. From this solution, 10ml was taken and diluted to 100ml with the buffer solution. Then the prepared solution was scanned in a wavelength at 265nm using UV spectrophotometer.

2.4.3. Determination of calibration curve:

The diluted stock solution was taken in the range of 5-25µg/ml in 100ml volumetric flask; the final volume was made by using pH 7.2 phosphate buffer solution. The diluted solutions absorbance was measured at265nm using UV spectrophotometer.

2.4.4. Percentage practical yield:

The formulated herbal gel was weighed accurately, and the percentage practical yield was calculated by using the formula:

$$(\%)\ \text{Yield} = \frac{\text{(Practical yield)}}{\text{(Theoretical yield)}} \times 100$$

2.4.5. Entrapment efficiency:

100mg *of Acalypha Indica* herbal gel were centrifuged at 2000rpm for 20 min, the free drug in the supernatant was determined at 265nm using UV-Visible spectrophotometer by using the formula:

$$\text{Entrapment efficiency } (\%) = \frac{\text{(Total amount of drug)} - \text{(amount of free drug)}}{\text{Total amount of drug}} \times 100$$

2.4.6. Drug content:

Acalypha Indica herbal gel equivalent to 10mg of material was taken into a100ml volumetric flask and dissolved in specified quantity of ethanol. Volume was adjusted and drug content was determined spectrophotometrically at 265nmusing UV spectrophotometer.

2.4.7. Evaluation of herbal gel of *Acalypha Indica*:

2.4.7.1. Homogeneity:

The optimized gel was tested for homogeneity by visual inspection. It was tested for their appearance and presence of any aggregates.

2.4.7.2. Measurement of pH:

The pH of the herbal gel was measured with the help of a digital pH meter. 0.5g of herbal gel was dissolved in 50ml of distilled water and stored for 2hrs. The measurement of pH of each formulation was determined.

2.4.7.2. Rheological study:

The measurements of viscosity of optimized gel were carried out with Brookfield Viscometer. The readings of formulation were taken.

2.4.7.3. Spreadability:

On a glass plate of 10×5cm, 350mg gel was taken and another plate of same sized was dropped from 5cm.After1minutethediameter of the circle spread was measured.

2.4.7.4. Extrudability: The study of extrudability was determined by measuring the weight (in grams) required to extrude at least 0.5cm gel from lacquered aluminum collapsible tube in 10sec. Then the extrudability was calculated by using the following formula.

2.4.7.6. Stability studies: The stability studies were conducted for the optimized formulation as per ICH guidelines. The sample was withdrawn at initial, 30th and 45th day and to analyze the physical appearance, drug content and percentage cumulative drug release.

3. RESULTS AND DISCUSSION:

3.1. Calibration curve of *Acalypha Indica* extract:

The λ-max Acalypha Indica of extract was determined by scanning the prepared solution in the wavelength range of 200-400 nm. The maximum wavelength was found to be 288 nm. The calibration curve of Acalypha Indica extract was constructed by dissolving the drug in pH 7.2phosphate buffer. The calibration curve obtained is shown in table.2, Figure. 2.

Table 2: Calibration curve obtained using these concentration verses absorbance at 320nm

Concentration (µg/ml)	Absorbance at 320nm
0	0
10	0.114
20	0.214
30	0.329
40	0.423
50	0.508
60	0.619

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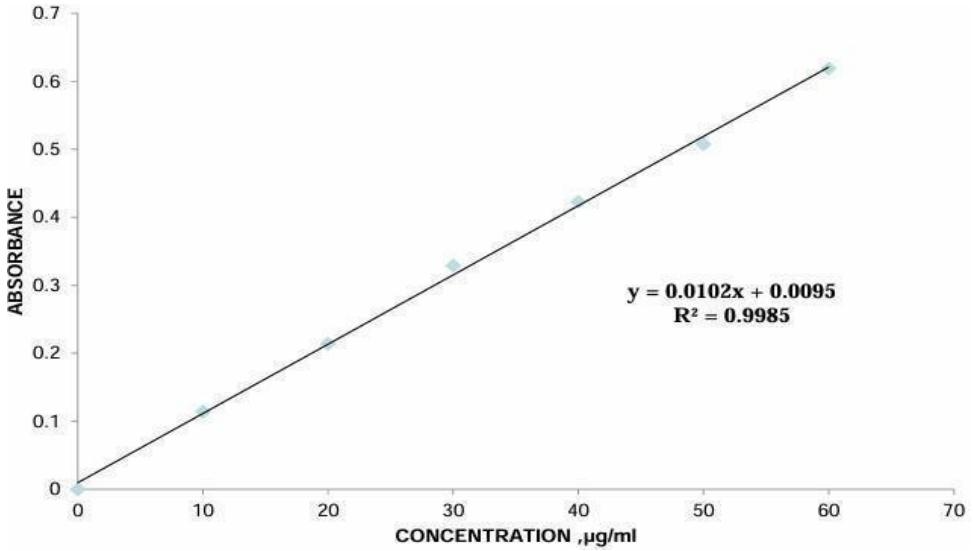

Fig 2: Calibration curve for Acalypha Indica

The Acalypha indica extract absorption spectrum was scanned between 200-400 nm in phosphate buffer. The maximum wavelength was found to be 288nm.

3.2. Percentage practical yield:

Formulation of Percentage Practical Yield which was found in F3 have higher Percentage Practical yield of 96.65% and it was depicted out in Table 3.

Table 3: Percentage practical yield

Formulation	Percentage Practical Yield
F1	90.28
F2	88.15
F3	**96.65**

3.3. Drug content

From formulation the drug content was found in F3, it has higher Percentage and drug content **of 93.65**%, and it was depicted out in Table 4.

Table 4: Drug Content

Formulation	Drug Content (%, W/W)
F1	87.03
F2	86.41
F3	**93.65**

3.4. Homogeneity of optimized Gel Formulation

From the visual inspection of the prepared gel formulation (F3) and it showed good appearance, which was showed in Table 5.

Table 5: Homogeneity of optimized Gel Formulation

Formulation	Homogeneity
Optimized gel	Good

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3.5. pH of Optimized Gel Formulation:

If the pH value of the optimized gel formulation is outside the desired range, consider adjusting it by adding small amounts of pH modifiers such as citric acid (to lower pH) or sodium hydroxide (to raise pH). Re-measure the pH after adjusting until the desired pH range is achieved, and it was shown in Table 6.

Table 6: pH of Optimized Gel Formulation

Formulation	pH
Optimized gel	5.8

3.6. Drug Content of different Gel Formulations:

The drug content of the optimized gel was estimated spectrophotometrically at265nm. The drug content in which the best formulation contained 93.65%, it was shown in Table 7.

Table 7: Drug Content of different Gel Formulations

Formulation	Drug Content (%)
Optimized gel	**93.65**

3.7. Spreadability of Optimized Gel Formulation

Spreadability denotes the extent of the area at which the gel readily spreads on applications to the skin or the affected part. The spreadability of the fabricated gel formulation was carried out and it was found at 5.5cm which indicated that it has a good spredability by showing the result in Table 8.

Table 8: Spreadability of Optimized Gel Formulation

Formulation	Spreadability (cm)
Optimized gel	**5.5**

3.8. Extrudability of optimized gel formulation:

The optimized gel formulation was shown optimum extrudability. Because the extrudability was decreased within the concentration of gelling agent and it was depicted in Table 9.

Table 9: Extrudability of optimized gel formulation

Formulation	Extrudability (gm/cm^2)
Optimized gel	9.6

3.9. Stability studies for optimized gel formulation:

The formulated herbal gel showed desirable physical characteristics such as smooth texture, acceptable pH range, and suitable viscosity for topical application. Stability studies indicated that the gel maintained its integrity and consistency over the study period under different storage conditions. In vitro skin permeation studies demonstrated that the herbal gel facilitated the permeation of bioactive compounds into the skin layers, suggesting its potential efficacy for dermatological applications and the results were showed in Table 10.

Table 10: Stability studies for optimized gel formulation

S. No	Parameters	Initial	30^{th}Day	45^{th}Day
1	Homogeneity	Good	Good	Good
2	Drug Content (%)	93.71	93.67	93.64
3	pH	5.8	5.8	5.8
4	Spreadability	5.5	5.5	5.4
5	Extrudability(gm/cm^2)	9.1	9.1	9.1

4.CONCLUSION:

The formulation and evaluation of the herbal gel incorporating Acalypha indica extract demonstrated promising results for potential dermatological applications. The developed herbal gel offers a natural and herbal alternative for addressing skin conditions like inflammation, wounds, and skin rejuvenation. Further studies focusing on in vivo efficacy, clinical trials, and formulation optimization can provide valuable insights into the therapeutic potential of the Acalypha indica herbal gel. This research article provides a structured outline for formulating and evaluating a herbal gel using Acalypha indica extract, emphasizing its potential for dermatological applications. Researchers can expand on this framework by conducting further studies to explore the therapeutic benefits and practical applications of the developed herbal gel.

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