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An In-Vivo Study on the Wound-Healing Potential of Barleria cristata and Mimosa pudica Polyherbal Nanogel

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Abstract

Wound healing is a complex biological process that can be delayed by inflammation, oxidative stress, and microbial infection. Medicinal plants such as Barleria cristata and Mimosa pudica have traditionally been used for wound-related disorders and possess reported antioxidant, anti-inflammatory, and antimicrobial activities. The present study aimed to develop and evaluate a polyherbal nanogel containing extracts of B. cristata and M. pudica for potential wound-healing applications.

The plant materials were collected, authenticated, shade-dried, powdered, and extracted using 70% ethanol by cold maceration. Individual and combined extracts were prepared and incorporated into a polymeric nanogel containing Carbopol 980, carboxymethyl cellulose, and polyvinyl alcohol. The prepared formulations were evaluated for organoleptic characteristics, homogeneity, pH, viscosity, spreadability, and other relevant physicochemical parameters.

The developed nanogel formulations exhibited acceptable appearance, smooth texture, good homogeneity, and satisfactory physical characteristics suitable for topical application. The combined herbal formulation demonstrated the potential advantages of incorporating both plant extracts into a single delivery system. The study suggests that the polyherbal nanogel may serve as a promising topical formulation for wound-healing applications. Further investigations, including in-vitro release, particle-size analysis, stability studies, and in-vivo wound-healing evaluation, are required to establish its therapeutic effectiveness.

Keywords: Barleria cristata, Mimosa pudica, Polyherbal nanogel, Wound healing, Herbal drug delivery, Topical formulation.

INTRODUCTION

Wound healing is a complex and highly coordinated biological process involving inflammation, cell proliferation, extracellular matrix formation, angiogenesis, collagen deposition, and tissue remodelling. Although the body possesses an inherent ability to repair damaged tissue, delayed wound healing may occur due to microbial infection, oxidative stress, prolonged inflammation, poor tissue regeneration, and other pathological conditions. Conventional topical preparations are widely used in wound management; however, limitations such as inadequate drug retention, poor penetration, frequent application, and the development of microbial resistance have encouraged the search for alternative and improved therapeutic approaches. (Ahmad H, et al.)

Medicinal plants have gained considerable attention as potential sources of bioactive compounds for wound management because of their diverse pharmacological activities, including antioxidant, anti-inflammatory, antibacterial, antifungal, and tissue-regenerative effects. Herbal medicines contain several phytoconstituents that may act through complementary mechanisms, making polyherbal therapy a promising approach for addressing the multiple biological stages involved in wound healing. (Ventura, et al)

Barleria cristata Linn., belonging to the family Acanthaceae and commonly known as Philippine violet, is a medicinal perennial shrub traditionally used for the management of inflammatory conditions, skin disorders, wounds, respiratory ailments, and other diseases. Previous studies have reported the presence of flavonoids, phenolic compounds, triterpenes, iridoidal glycosides, and phenylethanoid glycosides in different parts of the plant. Its reported antioxidant, anti-inflammatory, antibacterial, antifungal, and antidiabetic activities suggest that it may possess considerable therapeutic potential in wound care.

Mimosa pudica Linn., commonly known as the sensitive plant or touch-me-not, belongs to the family Fabaceae. The plant has been traditionally used in various systems of medicine for the treatment of wounds, inflammation, skin disorders, haemorrhoids, and other ailments. Phytochemical investigations have revealed the presence of tannins, flavonoids, alkaloids, saponins, phenolic compounds, terpenoids, glycosides, and other biologically active constituents. These compounds are associated with antioxidant, antimicrobial, anti-inflammatory, and wound-healing-related activities, supporting the potential use of *M. pudica* in topical herbal formulations. (Zhuang J, et al)

The combination of *B. cristata* and *M. pudica* may provide complementary pharmacological benefits through the combined action of their phytoconstituents. However, the therapeutic effectiveness of herbal extracts can be influenced by poor aqueous solubility, instability, limited penetration, and inadequate residence time at the wound site. Therefore, the development of an appropriate drug delivery system is essential to improve the topical performance of these plant extracts.

Nanogels are advanced topical drug delivery systems consisting of nanosized structures incorporated within a three-dimensional hydrophilic polymeric network. They combine the beneficial properties of nanoparticles and conventional hydrogels, including high water content, improved skin contact, enhanced drug loading, controlled release, good spreadability, and prolonged residence time. These properties make nanogels suitable carriers for herbal bioactive compounds intended for wound-healing applications. (Thayumanavan S et al.)

In the present study, extracts of *Barleria cristata* and *Mimosa pudica* were prepared using 70% ethanol and incorporated individually and in combination into a polymeric nanogel system. The developed formulations were evaluated for their physicochemical characteristics, including organoleptic properties, pH, viscosity, spreadability, homogeneity, and other relevant formulation parameters. The study was undertaken to investigate the feasibility of developing a polyherbal nanogel as a topical delivery system with potential application in wound-healing therapy. (Chacko RT, et al)

PLANT PROFILE:

Barleria cristata is a medicinal perennial shrub belonging to the family Acanthaceae and is widely distributed in India and other tropical Asian regions [Bhoomika & Shiju, 2024; Kumar et al., 2018]. The plant has been traditionally used in different ethnomedicinal systems for the treatment of inflammatory conditions, cough, asthma, bronchitis, toothache, anaemia, snakebite, wound healing, and skin infections, while modern studies have also reported anti-inflammatory, antibacterial, antifungal, antioxidant, and antidiabetic activities [Kumar et al., 2018; Mondal, 2024; *Barleria cristata* review, 2020. Others biological activities are present in *B. cristata*, such as hepatoprotective, anti-plasmodial, anti-inflammatory, antibacterial, antidiabetic, antioxidant activity.[Balkwill, M.J.; Balkwill, et al., K 1998].



Fig 1: Barleria cristata

BIOLOGICAL SOURCE

Barleria cristata L. is the biological source of the herbal drug, belonging to the family Acanthaceae and commonly known as Philippine violet. [Kumar S, et al.2018]

VERNACULAR NAME

1. Tamil – Nilamulli, Semmuli
2. English: Blue bell barleria, bluebell, Philippine violet
3. Japan: Barureria
4. Philippines: Kolintang, violeta
5. Thailand: Kaanchang, luemthaoyai, thong ra- aa
6. Tibet: Sa ha ra ca, sa ha ratsap, sa- ha- tsa
7. Vietnam: Hoach [oo]ng
8. India: Hindi – Raktajhinti;
9. Oriya – Banpatoli;
10. Telugu December Puvvulu, Peddagorinta
11. Sanskrit – Artagala, Bana

TAXONOMY OF BARLERIA CRISTATA

Kingdom	Plantae
Sub-kingdom	Tracheobionta
Division	Magnoliophyte
Class	Magnoliopsida
Sub-class	Asteridea
Order	Scrophulariales
Family	Acanthaceae
Genus	Barleria

CHEMICAL CONSTITUENTS

Barleria cristata contains various biologically active phytoconstituents, including flavonoids, phenolic compounds, triterpenes, iridoidal glycosides and phenylethanoid glycosides. Important compounds reported from the plant include oleanolic acid, p-coumaric acid, α -tocopherol, luteolin, 7-methoxy luteolin, quercetin, apigenin, naringenin, barlerin, shanzhiside methyl ester, desrhamnosyl acteoside and poliumoside. Preliminary phytochemical studies have also reported alkaloids, steroids, saponins, tannins and glycosides in different extracts of B. cristata. This study specifically reported p-coumaric acid, α -tocopherol, luteolin, 7-methoxy luteolin, barlerin and shanzhiside methyl ester from the leaves. [Hemalatha K, Hareeka N, et al., 2012.]

MIMOSA PUDICA

Mimosa pudica, or Sensitive Plant, represents one of the largest genera of flowering plants within the Fabaceae family. Fabaceae family members, including Mimosa pudica, are primarily from Central and South America [Kumar V. et al 2021]. Nowadays, Mimosa pudica, as well the other members of the Fabaceae family, are grown in Central and South America, and in all subtropical and tropical climates around the world. Mimosa pudica is a semi-woody plant with erect, branched stems, and with compound leaves that are bipinnate [Ahmad H, Sehgal S, Mishra A, Gupta R et al 2012]. Mimosa pudica has spinous stipules, glandular hairs, campanulate calyxes, and axillary heads of flowers which are lilac-pink. Mimosa pudica exhibits astonishment movements and enfolding of leaves and the behaviour is hypothesized as a means of avoiding herbivory [Azmi L, Singh MK, Akhtar AK et al 2015]. Apart from the behaviour that we find interesting, Mimosa pudica has been extensively studied in ayurvedic and traditional Chinese medicine for its antimicrobial, analgesic, anti-inflammatory, and wound healing properties. While a great amount of literature has been published around the world, literature around the plant's anti-inflammatory properties from a pharmacological perspective is significantly lacking [Pal P, Datta S, Basnett H, Shrestha B, Mohanty JP .et al 2019]. There is great need for the therapeutic potential of the plant to be explored firsthand through bioactive compound identification and subsequent extraction processes.



Fig 2: Mimosa pudica

BIOLOGICAL SOURCE

Mimosa pudica L. is the biological source of the drug, belonging to the family Fabaceae (Mimosaceae), and the whole plant, especially the roots and leaves, is used for medicinal purposes. [Ajaz HM et al. Mimosa pudica L. Et al.,2016]

VERNACULAR NAME

1. English – Sensitive plant, touch-me-not, shame plant, sleeping grass
2. Hindi – Lajjavanti, Chuimui,
3. Bengali – Lajjabati,
4. Tamil – Thottal surungi, Thottaladi,
5. Telugu – Attapatti, Peddanidrakanni
6. Kannada – Lajja, Nachika, Mudugu-davare
7. Malayalam – Thottavadi,
8. Sanskrit – Lajja, Lajjal,
9. Malay/Indonesian – Semalu, Puteri malu,
10. Tagalog – Makahiy

TAXONOMY OF MIMOSA PUDICA

Category	Classification
Kingdom	Plantae

Division	Magnoliophyta
Class	Magnoliopsida
Order	Fabales
Family	Fabaceae / Mimosaceae
Sub-family	Mimosoideae
Genus	Mimosa
Species	Pudica

CHEMICAL CONSTITUENTS OF MIMOSA PUDICA

1. Leaves

Leaves are bitter, tonic, and used in hemorrhoids, conjunctivitis, cuts, wounds, scrofula, and hemorrhages [36]. The initial phytochemical screening has shown the presence of tannins, saponins, quinines, alkaloids, phenols, flavonoids, coumarins, and terpenoids in the leaf extract of mimosa pudica. The main constituent in the leaf is Mimosine an alkaloid which is considered a toxic alkaloid and tends to have potent apoptotic and antiproliferative effects. It also contains polyunsaturated fatty acids, nor epinephrine, d-pinitol, b-sitosterol, 5-MeO-DMT, 6,7,3',4'-tetrahydroxy-6-C-D-apiose D-glucopyranosyl flavone, isorientin, orientin, Isovitexin, vitexin, tyrosine. Leaf extracts contain adrenaline-like substances. Periodic Leaf movement factors are reportedly the derivatives of 4- α -(b-D-Glucopyranosyl-6-sulphate) Gallic acid [37,38].

2. Root

Roots are bitter, resolvent, astringent, acrid, used as antispasmodic, emetic, diuretic, ulcers, inflammations, dysentery, burning sensation, asthma, jaundice, smallpox, hemorrhoids, vaginopathy, leucoderma, fevers, spasmodic infections [36]. Mimosa pudica roots mainly consist of flavonoids, glycosides, fatty acids, alkaloids, phytosterol, amino acids, ascorbic acid, linolenic acid, linoleic acid, palmitic acid, stearic acids, D-glucuronic acid, D-sitosterol, mimosine. Aqueous extracts of M.pudica roots have neutralizing effects on the infectious venom of the Indian spitting cobra or monocled cobra (Najakaouthia) by inhibiting the enzyme activity and the myotoxicity of the venom. Roots also contain 10% of tannins. [37,38]

3. Seed

Chemical constituents present in the seed are phenolic ketone, C-glycosyl flavones, tubulin, and bufadienolides. The mucilage present in the seed is composed of d-xylose and d-glucuronic acid.

4. Plant

Plant extract of mimosa pudica contains 17% green-yellow fatty oil. It also comprises tubulin, jasmonic acid, abscisic acid, mimosinic acid, mimosinamine, gallic acid, d-xylose, d-glucuronic acid, norepinephrine, thiamine, L-Noradrenaline, mimopudine, etc.

MATERIAL AND METHOD

COLLECTION AND PREPARATION:

The Barleria Cristata Linn were collected from Courtallam, tenkasi district, Tamilnadu, India during March 2026.

The Mimosa pudica Linn were collected from, Vandiperiyar, Idukki district, Kerala, India during March 2026.

Authentication:

Raw materials procured from market and were authenticated by a Botanist Dr. V. Manimekalai, Professor and Head, Department of Botany, Sri Parashakthi College for Woman Courtallam.

Preparation:

1. Authenticated materials were thoroughly cleaned and dried under shaded.

2. Dried materials were pulverized using manual and mechanical method.
3. The powder material was sieved
4. Coarse powder is made and used for formulation development.

Novel drug delivery system:

Nanogels are nanosized hydrogel systems composed of a three-dimensional polymeric network capable of retaining water. They combine the advantages of nanoparticles and conventional hydrogels and are therefore suitable for topical and transdermal delivery (Moghimipour et al., 2012; Soni et al., 2022). Nanogels can improve surface area, skin contact, drug loading and controlled release. The hydrogel matrix also provides good spreadability, hydration and prolonged residence time on the skin, which is particularly useful for anti-inflammatory applications (Moghimipour et al., 2012). A nanogel containing *M. pudica* and *B. cristata* extracts may improve topical delivery of phytoconstituents, protect sensitive compounds from degradation and provide prolonged anti-inflammatory action at the site of application.



Fig 3: Novel drug delivery system

Formulation of nanogel

Nanogel formulation is an effective strategy for topical delivery because it combines the advantages of nanoparticles and hydrogels. In this system, the herbal extract is incorporated into a three-dimensional polymer network, which helps retain moisture, protect the active compounds and release them in a controlled manner at the wound site (Moghimipour et al., 2012; Patel et al., 2024).

Common polymers used in nanogel preparation include Carbopol, chitosan, sodium alginate, HPMC and other biocompatible materials. The selection of polymer is important because it affects viscosity, pH, spreadability, entrapment efficiency, stability and release behaviour of the final formulation (Moghimipour et al., 2012; Kumar and Verma, 2025).

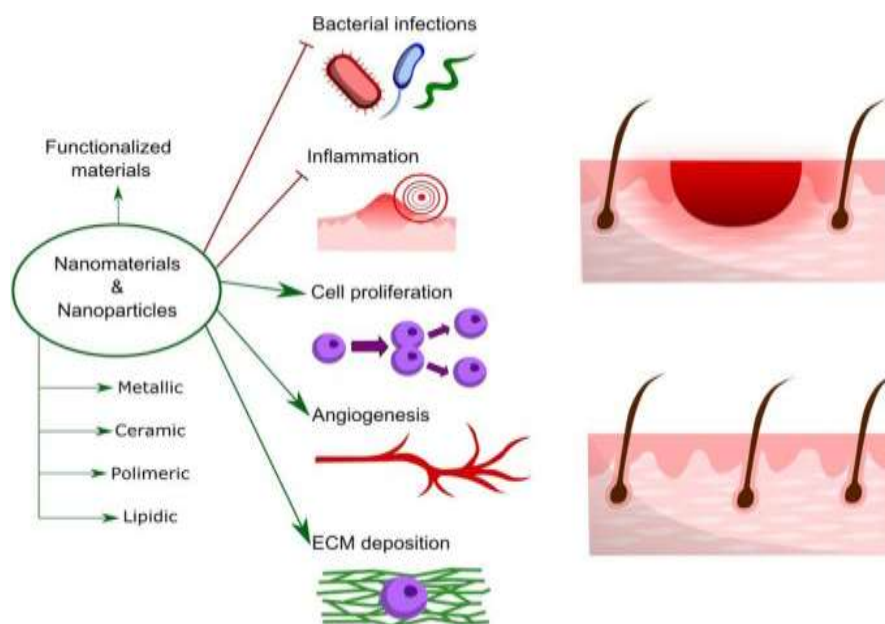


Fig 4: Nanomaterials and Nanoparticles

The formulation process generally includes extraction of plant material, preparation of the polymer base, dispersion or incorporation of the extract, pH adjustment and homogenisation to obtain a smooth and uniform nanogel. Proper optimisation is necessary to achieve the desired particle size, drug content and release profile (Khurana et al., 2018; Patel et al., 2024).

Nanogel benefits

Nanogels offer several advantages in wound healing applications. They provide high water content, good biocompatibility, enhanced drug loading, controlled release and improved contact with the wound surface, which together support faster tissue repair (Ranjbar et al., 2024; Zhang et al., 2025). Another major benefit of nanogel is its ability to maintain a moist environment at the wound bed. Moisture is essential for cell migration, granulation tissue formation and epithelialisation. At the same time, the nanogel can absorb exudate and reduce the risk of secondary infection, making it suitable for chronic and infected wounds (Zhang et al., 2025; Brown et al., 2024).

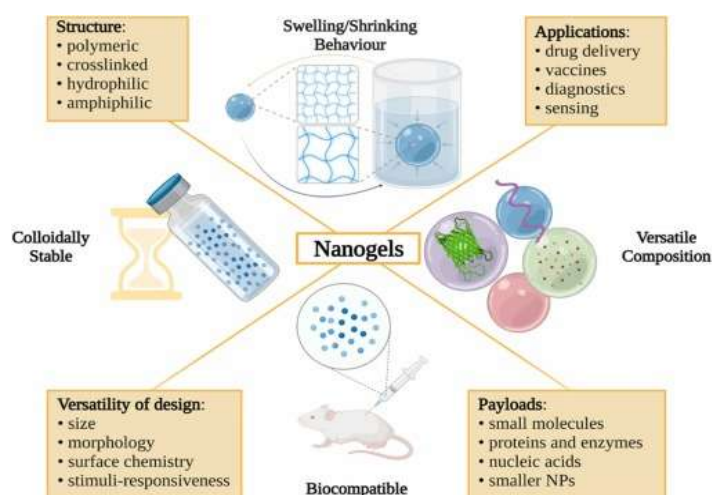


Fig 5: Nanogel benefits

Nanogels can also protect sensitive herbal constituents from degradation by light, heat and oxidation. This improves formulation stability and allows prolonged availability of phytoconstituents at the site of action. Because of these features, nanogel systems are considered more effective than simple gels for many topical applications (Singh et al., 2025; Ranjbar et al., 2024).

Evaluation of nanogel

The prepared nanogel should be evaluated for appearance, homogeneity, pH, viscosity, spreadability and extrudability to confirm its suitability for topical application. Particle size, zeta potential and polydispersity index are also important because they influence formulation stability and release behaviour (Kumar and Verma, 2025; Patel et al., 2024).

In-vitro release studies help determine how the herbal actives are liberated from the formulation, while stability testing confirms whether the nanogel remains physically acceptable during storage. Skin irritation studies are also necessary to ensure that the formulation is safe for topical use (Kumar and Verma, 2025; Brown et al., 2024).

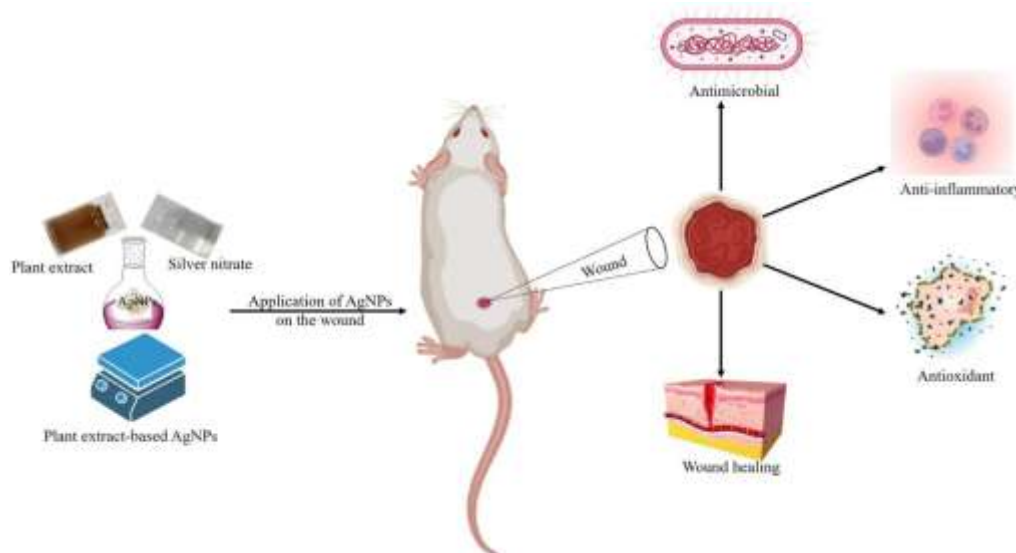


Fig 6: Evaluation of nanogel

Need for the study

Although *Mimosa pudica* and *Barleria cristata* have reported wound-related pharmacological activities, limited information is available on a combined polyherbal nanogel formulation for wound healing. A nanogel based on these extracts may offer improved drug delivery, better wound contact and enhanced healing potential (Nayak et al., 2009; Ranjbar et al., 2024).

Hence, the present study is designed to formulate and evaluate a polyherbal nanogel based on *Barleria cristata* and *Mimosa pudica* extract as a novel approach for wound healing therapy (Shah et al., 2024; Singh et al., 2025)

FORMULATION RATIO AND AMOUNT OF DRUG POWDER

EXTRACTION OF PLANT MATERIAL:

The Whole plants were washed three times with tap water to remove dirt and leaves were dried in the shade at room temperature. A coarse powder of the dried leaves are obtained by blending the leaves. Then, coarse powder is used for solvent extraction. Coarse leaf powder of *Barleria Cristata* and *Mimosa pudica* (50g) was macerated for 3 days in 500ml of 70% ethanol by using the cold maceration extraction method. Concentrated the extracts using an evaporation technique and stored in an airtight container at a cool temperature for future use.

S.no	Formulation	Barleria Cristata	Mimosa pudica	Solvent
1.	F1	50 gm	-	70%ethanol
2.	F2	-	50 gm	70%ethanol
3.	F3	50 gm	50 gm	70%ethanol

PREPARATION OF POLYMER:

Requirment: CMC (carboxy methyl cellulose), carbopol 980, poly vinyl alcohol.FR

Ingredient	Function
Carbopol 980	Primary gelling/polymerizing agent
Carboxymethyl Cellulose (CMC)	Viscosity enhancer and stabilizer
Polyvinyl Alcohol (PVA)	Film-forming/stabilizing polymer
Purified water	Vehicle

Accurately weigh 0.75 g Carbopol 980 and disperse it in 40 mL purified water with continuous stirring, then allow it to hydrate for 2–4 hours. Disperse 0.75 g CMC separately in 20 mL purified water with continuous stirring until uniformly hydrated.

Dissolve 1.5 g PVA in 30 mL purified water by heating at 80–90°C with continuous stirring. Mix the hydrated Carbopol 980 and CMC dispersions gradually with continuous stirring.

Add the cooled PVA solution slowly and stir until a uniform polymeric dispersion is obtained. Finally, make up the volume to 100 mL with purified water and allow it to stand until air bubbles are removed.

Formulation of Nanogel:

Accurately weighed quantity of extract, propylene glycol, ethyl cellulose and sodium benzoate as a stabilizer were mixed with glycerol with continuous stirring. The aqueous phase prepared using carbopol-940 dissolve in water with continuous stirring and heat. The drug containing phase was sonicated on ultrasonicator. The drug phase was added drop by drop into aqueous phase and obtained formulation was homogenized using homogenization technique for 1hr. Triethanolamine was added to adjust the pH of formulation. The prepared nanogel was further evaluated. (Jain et al.)

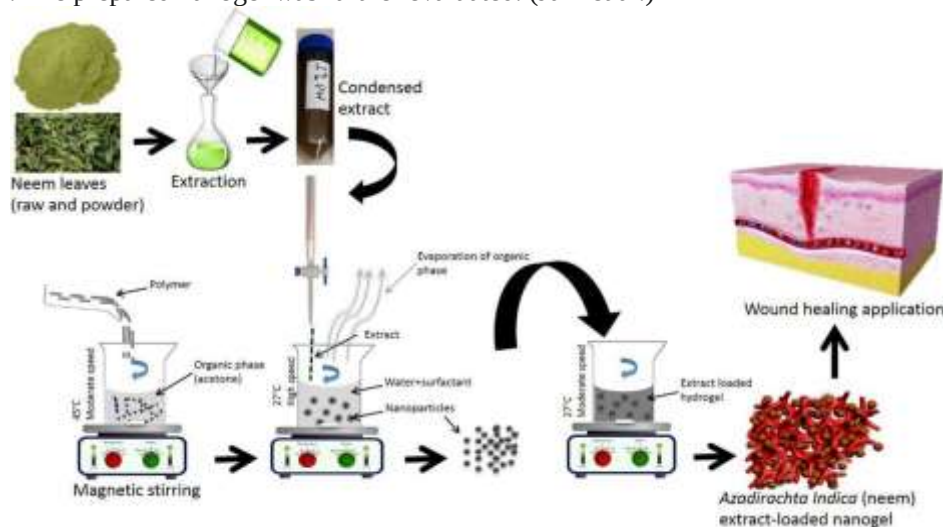


Fig 7: Formulation of nanogel

pH of nanogel:

S.no	Formulation	pH
1.	F1	6.2
2.	F2	7.4
3.	F3	6.8

Result:

The pH of the prepared nanogel formulation containing Mimosa pudica leaf extract, Barleria Cristata extract and combined mixture of leaf extract was determined by using calibrated digital pH mete. The pH value for various formulation like F1, F2 and F3 was 6.2,7.4 and 6.8 respectively.

Discussion

The pH of the prepared nanogel formulations was determined using a calibrated digital pH meter. The pH values of F1, F2, and F3 were found to be 6.2, 7.4, and 6.8, respectively. The formulations showed pH values ranging from slightly acidic to nearly neutral. F1 showed a slightly acidic pH, while F2 showed a near-neutral pH.

F3 exhibited an intermediate pH of 6.8. The observed pH values indicate acceptable compatibility of the formulations for topical application. The results suggest that the incorporation of the herbal extracts did not cause excessive changes in the formulation pH. Overall, all three nanogel formulations showed satisfactory pH characteristics for further evaluation.

Viscosity of nanogel:

S.no	Formulation	Viscosity
1.	F1	25cP
2.	F2	20cP
3.	F3	22cP

Result:

The viscosity of the prepared nanogel was determined by using capillary viscometers. The viscosity value of the given formulation of F1 25 cP, F2 20 cP and for F3 22 cP respectively.

Discussion:

F1 showed the highest viscosity, while F2 showed the lowest viscosity among the formulations. F3 exhibited an intermediate viscosity value. The slight variation in viscosity may be due to differences in the incorporated herbal extracts and their interaction with the gel base. The obtained viscosity indicates acceptable consistency and ease of application of the formulations. Overall, all three formulations showed satisfactory viscosity characteristics suitable for further evaluation of the nanogel.

Spreadability of nanogel:

S.no	Formulation	Spreadability of nanogel
1.	F1	5.8 cm
2.	F2	6.5 cm
3.	F3	7.0 cm

Result:

The spreadability of given nanogel formulation by using various concentration formulation was found to be 5.8 cm, 6.5 cm, 7.0 cm respectively.

Discussion:

Good spreadability indicates that the nanogel can be applied uniformly over the skin with minimal effort. The results demonstrate that all formulations possessed satisfactory spreading properties. Overall, F3 showed the best spreadability among the tested formulations and may be considered suitable for further evaluation.

EVALUATION OF NANOGE:

The nanogel were evaluated for these parameter: physical appearance, determination of pH, estimation of practical yield, determination of homogeneity, estimation of drug content uniformity, determination of spreadability, determination of viscosity, in-vitro drug release study, Zeta potential and particle size analysis, FTIR study of nanogel, SEM (Scanning electron microscope) etc. (Talele et al.)

The prepared extracted polyherbal nanogel were evaluated as mentioned below.

1. Organoleptic Characteristics:

The prepared nanogel was visually examined for colour, clarity, smoothness, and the presence of any lumps or phase separation. A small amount of formulation was spread on a clean glass slide and observed

under light to confirm uniformity. Homogeneity was considered satisfactory when the gel appeared smooth, uniform, and free from visible particles.

2. pH Determination

The pH of the nanogel was determined using a calibrated digital pH meter. About 1 g of the formulation was dispersed in 10 mL of distilled water and the electrode was immersed in the sample. The pH reading was recorded after stabilization, and the measurement was repeated three times to obtain the average value. (Anusiya Patil,)

3. Viscosity Measurement

The viscosity of the nanogel was measured using a Brookfield viscometer. A suitable amount of the formulation was placed in a beaker, and the spindle was immersed in the sample. The viscosity was recorded at a constant speed and temperature. The reading was taken in triplicate, and the average value was reported.

4. Spreadability Test: (Jade Mistry and Rebecca Notman,).

Spreadability was evaluated to determine the ease with which the nanogel could spread on the skin surface. A known quantity of gel was placed between two glass slides. A specified weight was applied on the upper slide, and the time taken for the slide to move a fixed distance was recorded. Spreadability was calculated using the formula:

$$S = (M \times L) / T$$

Where M= weight tied to the upper slide, L= distance travelled, and T= time taken.

EXPERIMENTAL ANIMAL STUDIES

Ethical Approval

Animals

The healthy Wistar albino rats of either sex, weighing 150–200g, were housed under standard environmental conditions of temperature and humidity ($25 \pm 0.50^\circ\text{C}$) and 12h light/dark cycle) were utilized for the studies. The animals were fed with standard pellet diet and water ad libitum. The animal studies were performed in Fig. 1. A circular excision wound on the day 0. the institute with due permission from Institutional Animal Ethical Committee (registration no. 704/CPCSEA, India dated 25/8/2003).

Wound healing activity

The animals were grouped into three major groups viz. control, standard and test with six animals in each group. The control group was treated With simple ointment base B.P. The standard group was treated with povidone ointment. The test groups were treated with ointments with different concentrations of extracts viz. 5% (w/w) and 10% (w/w) incorporated in simple ointment base, in all the three models.

Excision wound model

The rats were anesthetized by administering chloroform (0.5ml/kg b. w. i.p.). A full thickness of the excision wound of circular area (approx. 500mm²) and 2mm depth was made on the shaved back of the rats 30min later the administration of chloroform. The wounding day was considered as day 0 (Fig. 1). The wounds were treated with topical application of the ointments as described above till the wounds were completely healed. The wounds were monitored and the area of wound was measured on 4, 6, 8, 10, 12, 14, 16 post-wounding days and the mean % wound closure is reported in Table 1. The period of epithelization was calculated as the number of days required for falling of the dead tissue remnants without any residual raw wound (Nayak et al., 2007). Wound healing rate (Muthusamy et al., 2008)



Fig 8: circular excision wound on the day 0.

Result and discussion:

Organoleptic characteristics of formulation:

S. No	Formulation	Colour	Odour	Appearance	Texture	Homogeneity Phase	Separation
1.	Blank nanogel	Milky white	Bland odour	Clarity	Smoothness	Smooth	Good
2.	F1	Pale yellow colour	Characteristic odour	Clarity	Smoothness	Smooth	Good
3.	F2	Green colour	Characteristic odour	Clarity	Smoothness	Smooth	Good
4.	F3	Greenish yellow colour	Characteristic odour	Clarity	Smoothness	Smooth	Good

Result

The prepared nanogel formulations containing *Mimosa pudica* leaf extract, *Barleria cristata* extract, and their combined extract were evaluated for organoleptic characteristics. The formulations exhibited a smooth appearance, uniform texture, characteristic herbal odour, and good homogeneity, with no visible phase separation observed.

Discussion:

All formulations exhibited a characteristic herbal odour and smooth texture.

Good homogeneity indicated uniform distribution of the herbal extracts throughout the nanogel. The formulations showed a clear and smooth appearance without any visible lumps or aggregates. No visible phase separation was observed, indicating good physical stability of the formulations. Overall, the organoleptic properties were satisfactory and suitable for further evaluation of the prepared nanogels.

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Good spreadability indicates that the nanogel can be applied uniformly over the skin with minimal effort. The results demonstrate that all formulations possessed satisfactory spreading properties. Overall, F3 showed the best spreadability among the tested formulations and may be considered suitable for further evaluation.

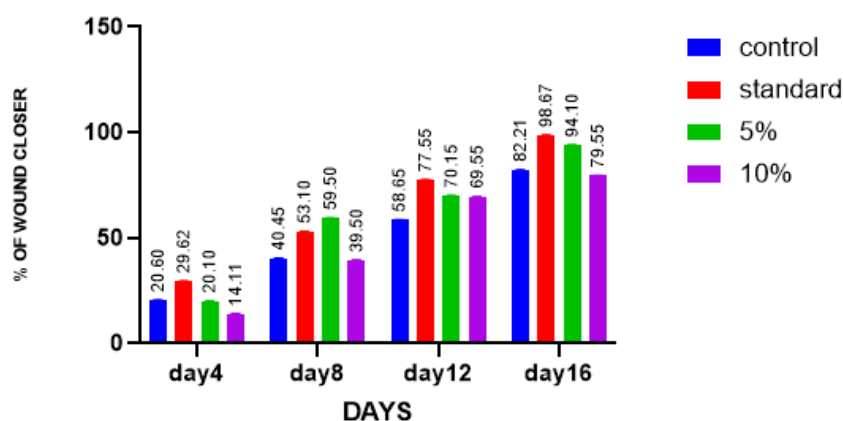
Table 1 Effect of topical application of polyherbal nanogel extract of Mimosa pudica and berleria cristata on wound contraction of excision wound

GROUP	4 th DAY	8 th DAY	12 th DAY	16 th DAY	P VALUE
CONTROL	20.60±0.04619	40.45±0.05235	58.65±0.07638	82.21±0.22790	0.5373
STANDARD	29.62±0.07257***	53.10±0.09227 ***	77.55±0.09227 ***	98.67±0.09087 ***	0.8805
5% OF MPBC CONTAINING NANOGEL	20.10±0.07439 **	59.50±0.10770 **	70.15±0.09102 * *	94.10±0.08760 **	0.4925
10%OF MPBC CONTAINING NANOGEL	14.11±0.20210 * *	39.50±0.10200 **	69.55±0.09114 **	79.55±0.09114 **	0.5325

SO, simple ointment base.

n=6animals in each group.

The treated groups are compared by ONE WAY ANOVA followed by with the control group.

Effect of polyherbal nanogel of MPBC on wound contraction in excision wound

Statistical analysis

Results obtained from the three wound models have been expressed as mean ± SEM and were compared with the corresponding control group (simple ointment B.P.) by applying ANOVA test (Mukherjee et al., 2000)

REFERENCE

- Ahmad H, et al. Phytochemistry and diverse pharmacology of genus *Mimosa*. *Biomedicine & Pharmacotherapy*. 2022.pmc.ncbi.nlm.nih
- Chacko RT, Ventura J, Zhuang J, Thayumanavan S. Polymer nanogels: A versatile nanoscopic drug delivery platform. *Advanced Drug Delivery Reviews*. 2012; 64(9):836–851. doi:10.1016/j.addr.2012.02.002.pubmed.ncbi.nlm.nih
- Kumar A, Sharma R, Verma P. Herbal approaches in wound healing: A review. *J Pharm Res*. 2013; 7(3):217-222.
- Gambhire MN, Wankhede SS, Juvekar AR. Antiinflammatory activity of aqueous extract of *Barleria cristata* leaves. *Journal of Young Pharmacists*. 2009;1(3):220–224.jyoungpharm
- Hossain H, et al. Suppressive effects of *Mimosa pudica* constituents on inflammatory mediators. *EXCLI Journal*. 2014;13:1011–1021.pmc.ncbi.nlm.nih
- Jaiswal D, et al. Pharmacological evaluation of *Barleria cristata* extracts for anti-inflammatory activity. *International Journal of Pharmaceutical Sciences and Research*. 2012.technologyjournal

7. Kumar S, et al. A review on phytochemical and pharmacological activity of Barleria cristata. Research Journal of Pharmacy and Technology. 2020.ijpjournal
8. Muslim MRF, Chabib L, Hamzah H. Nano-hydrogel systems in herbal medicine: A systematic review. Journal of Herbmed Pharmacology. 2025; 14(2):153–162. Doi:10.34172/jhp.2025.52822. herbmedpharmacol
9. Nair PV, Nair BLR. Anti-inflammatory activity of hydroalcoholic extract of Mimosa pudica whole plant in rats. International Journal of Basic & Clinical Pharmacology. 2017.ijbcp
10. Thakur, M., et al. Green extraction of Millettia pinnata oil for the development and characterization of pectin-crosslinked carboxymethyl cellulose/guar gum herbal nanohydrogel. Frontiers in Chemistry. 2023.frontiersin
11. Márquez, A. L., et al. Application of CMC as thickener on nanoemulsions based on olive oil: Physical properties and stability. Journal of Chemistry. 2016.onlinelibrary.wiley
12. Prasetyo, B. E., Laila, L., and Hanum, T. I. S. Physical characterization of nanoemulgel containing ethanol extract of Curcuma mangga Val. Using Carbopol 940 as gelling agent. Research Journal of Pharmacy and Technology. 2022;15(7).rjptonline
13. Mandal, S., et al. Modern herbal nanogels: Formulation, delivery methods, and applications. Gels. 2022;8(2):97.pmc.ncbi.nlm.nih
14. A. P., et al. Effect of variation in type and concentration of gelling agents on the physical properties of nanoemulgel preparations. International Journal of Applied Pharmaceutics. etd.repository.ugm.ac
15. Sujatha, R., et al. Formulation and evaluation of a novel herbal trio gel containing flaxseed extract, Carbopol, and carboxymethyl cellulose. Journal of Pharmacy and Bioallied Sciences. 2023.
16. Ahmad H, et al. Phytochemistry and diverse pharmacology of genus Mimosa. Biomedicine & Pharmacotherapy. 2022.pmc.ncbi.nlm.nih
17. Chacko RT, Ventura J, Zhuang J, Thayumanavan S. Polymer nanogels: A versatile nanoscopic drug delivery platform. Advanced Drug Delivery Reviews. 2012; 64(9):836–851. Doi:10.1016/j.addr.2012.02.002.pubmed.ncbi.nlm.nih
18. Fatima Z, Jorge A. Innovative wound therapy: The role of herbal nano formulations. World Journal of Advanced Research and Reviews. 2024; 23(3):1009–1035. Doi:10.30574/wjarr.2024.23.3.2646.wjarr
19. Gambhire MN, Wankhede SS, Juvekar AR. Antiinflammatory activity of aqueous extract of Barleria cristata leaves. Journal of Young Pharmacists. 2009;1(3):220–224.jyoungpharm
20. Hossain H, et al. Suppressive effects of Mimosa pudica constituents on inflammatory mediators. EXCLI Journal. 2014;13:1011–1021.pmc.ncbi.nlm.nih
21. Jaiswal D, et al. Pharmacological evaluation of Barleria cristata extracts for anti-inflammatory activity. International Journal of Pharmaceutical Sciences and Research. 2012.technologyjournal