WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
Coden USA: WJPRAP Impact Factor 8.63
Volume 15, Issue 13, 993-1006. Research Article ISSN 2277–7105

A RESEARCH ON: FORMULATION AND EVALUATION OF NYCTANTHES ARBOR AND CALOTROPIS GIGANTEAN CONTAINING EMUGEL FOR RHEUMATOID ARTHRITIS

***Rutuja Satish Modhave,*Shraddha Madan Khaladkar,*Payal Hemant Padwal, *Jayshree Ravindra Matade**

Student of Samartha Institute of Pharmacy, Belhe, Pune, Maharashtra, India.

Article Received on 02 June 2026,
Article Revised on 22 June 2026,
Article Published on 01 July 2026,

https://doi.org/10.5281/zenodo.21031657

***Corresponding Author**

Rutuja Satish Modhave

Student of Samartha Institute of Pharmacy, Belhe, Pune, Maharashtra, India.

How to cite this Article: *Rutuja Satish Modhave,*Shraddha Madan Khaladkar,*Payal Hemant Padwal, *Jayshree Ravindra Matade. (2026). A Research On: Formulation And Evaluation Of Nyctanthes Arbor And Calotropis Gigantean Containing Emugel For Rheumatoid Arthritis. World Journal of Pharmaceutical Research, 15(13), 993–1006.

ABSTRACT

Rheumatoid arthritis (RA) is a chronic autoimmune inflammatory disorder characterized by persistent synovial inflammation, joint pain, swelling, stiffness, and progressive destruction of cartilage and bone. Because conventional systemic therapy may cause gastrointestinal, hepatic, renal, and immunological adverse effects, topical herbal drug delivery systems are increasingly explored as safer alternatives for local symptom control. In this study, a combined herbal emulgel containing extracts of Nyctanthes arbor-tristis and Calotropis gigantea was designed for topical management of RA. Nyctanthes arbor-tristis has documented anti-rheumatic activity in FCA-induced arthritis models, with reduction in paw edema, arthritic index, TNF-α, COX-2, rheumatoid factor, and histopathological joint damage.[1] Its phytochemicals also show favorable anti-inflammatory interactions with COX-2 and cytokine-related targets in computational studies.[2] Calotropis gigantea has similarly shown anti-arthritic, antioxidant, and immunomodulatory activity in CFA-induced arthritis, including downregulation of IL-6, TNF-α, NF-κB, and COX-2.[3] Emulgel was selected because it combines the favorable spreadability of gels with the drug-loading and permeation advantages of emulsions, making it suitable for topical anti-inflammatory delivery.[4,5] The present manuscript describes the formulation of 20 g batches, evaluation parameters, and a structured research-paper format suitable for academic submission. The optimized emulgel is

expected to show acceptable pH, good homogeneity, adequate spreadability, sustained release, and improved local delivery for RA symptom management.

KEYWORDS: Nyctanthes arbor, calotropis gigantea, anti-inflammatory activity, herbal formulation, topical drug delivery, arthritis management.

INTRODUCTION

Rheumatoid arthritis is a systemic, inflammatory, autoimmune disease that primarily affects synovial joints and leads to pain, swelling, morning stiffness, deformity, and loss of function. Its pathogenesis involves immune dysregulation, excessive production of inflammatory cytokines such as TNF-α, IL-1β, and IL-6, activation of NF-κB signaling, oxidative stress, and progressive synovial proliferation. These molecular events drive pannus formation and cartilage erosion.

Although disease-modifying antirheumatic drugs and NSAIDs are widely used, long-term oral therapy is often limited by systemic adverse effects and incomplete local control of inflammation. As a result, topical formulations are attractive for providing targeted relief, improved patient compliance, and reduced systemic exposure. Recent RA-oriented transdermal studies support this strategy, showing that gel-based emulsified systems can enhance skin deposition, prolong release, and reduce paw edema in arthritic models.[4,5]

Nyctanthes arbor-tristis commonly known as Night Jasmine or Parijat possesses anti-inflammatory, analgesic, antioxidant, and immunomodulatory activities. Calotropis gigantea is widely used in traditional medicine for treating pain, inflammation, and rheumatic disorders. Combining these medicinal plants into a topical herbal formulation may provide synergistic therapeutic effects in rheumatoid arthritis treatment.

The present study aims to formulate and evaluate a herbal gel containing extracts of Nyctanthes arbor-tristis and Calotropis gigantea for anti-arthritic activity. An emulgel was therefore selected as the dosage form because it is especially useful for herbal extracts, particularly when the active constituents are partly lipophilic and need better skin penetration and patient acceptability. Emulgels also support uniform application, aesthetic appeal, and sustained release.[5]

OBJECTIVE

1. To formulate and evaluate a topical emulgel containing Nyctanthes arbor-tristis and Calotropis gigantea extracts for rheumatoid arthritis.
2. To collect, identify, and authenticate the leaves of Nyctanthes arbor-tristis and Calotropis gigantea.
3. To prepare herbal extracts using suitable extraction methods.
4. To evaluate the phytochemical constituents present in both plant extracts.
5. To formulate the extracts into a suitable topical dosage form such as gel or emulgel.
6. To study the anti-inflammatory potential of the herbal formulation for rheumatoid arthritis management.
7. To compare different batches of formulation and select the optimized batch based on evaluation parameters.
8. To determine the safety and effectiveness of the developed herbal formulation for topical application.

PLANT PROFILE

1. Nyctanthes arbor-tristis L.

- Family: Oleaceae
- Common names: Night jasmine, Parijat, Harsingar
- Plant part used: Leaves, flowers, tubular calyx
- Traditional use: Rheumatism, inflammatory disorders, fever, pain
- Major phytoconstituents: Iridoids, flavonoids, alkaloids, phenolics, sterols, terpenoids
- Reported pharmacological activities: Anti-inflammatory, anti-arthritic, antioxidant, analgesic, immunomodulatory.[1,6,2]
- RA-relevant evidence: Reduction in paw edema, joint inflammation, rheumatoid factor, TNF-α, COX-2, and histological joint damage in arthritis models

Figure No. 1: Nyctanthes arbor-tristis L.

2. Calotropis gigantea L.

- Family: Apocynaceae
- Common names: Crown flower, Akanda
- Plant part used: Leaves, flowers, latex
- Traditional use: Joint pain, inflammation, wounds, swelling
- Major phytoconstituents: Flavonoids, terpenoids, phenolic compounds, steroids, fatty acids
- Reported pharmacological activities: Anti-inflammatory, anti-arthritic, antioxidant, wound-healing
- RA-relevant evidence: Significant reduction in arthritic score, paw edema, CRP, RF, IL-6, TNF-α, NF-κB, and COX-2 in CFA-induced arthritis

Figure No. 2: Calotropis gigantea L.

MATERIALS AND METHODS

Material and Methods

Materials

Plant materials

- Dried leaves of Nyctanthes arbor-tristis
- Dried flowers or leaves of Calotropis gigantean

Excipients

- Carbopol 934
- Liquid paraffin
- Tween 80
- Propylene glycol
- Methyl paraben
- Propyl paraben
- Triethanolamine
- Purified water
- Ethanol or hydroalcoholic solvent for extraction

Preparation of Plant Extracts

- The dried plant materials were cleaned, shade-dried, and powdered.
- Separate extraction of each plant powder was performed using hydroalcoholic solvent by maceration or Soxhlet extraction.
- Extracts were filtered and concentrated under reduced pressure.
- The dried extracts were stored in airtight containers until further use.
- Preliminary phytochemical screening may be carried out for alkaloids, flavonoids, glycosides, tannins, phenols, steroids, and terpenoids.

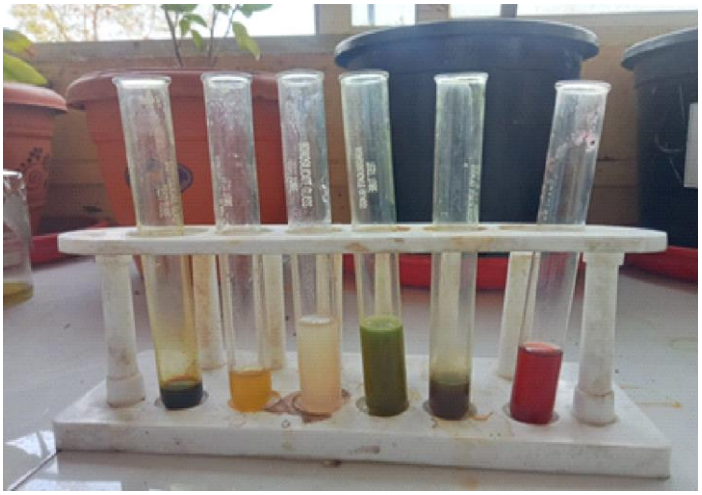

Figure No. 3: Phytochemical screening test.

Sr. No.	Phytochemical Constituent	Test Performed	Observation	Result
1	Saponins	Foam Test	Stable persistent froth formed	Present (+)
2	Tannins	Ferric Chloride/Tannin Test	Blue black-green precipitate observed	Present (+)
3	Glycosides	Keller–Killiani Test	Reddish-brown ring formed at interface	Present (+)
4	Flavonoids	Shinoda Test	Yellow/cream coloration observed	Present (+)
5	Alkaloids	Dragendorff's Test	Orange-brown precipitate formed	Present (+)
6	Saponins	Foam Test	Stable persistent froth formed	Present (+)
7	Carbohydrates	Molisch's Test	Violet ring formed at junction	Present (+)

Formulation Design: 20 g per Batch

Below is a suitable example for three pilot batches.

Table 1: Composition of herbal emulgel preparation (20g each).

INGREDIENT	F1	F2	F3
Nyctanthes arbor-extract	1.0%	1.5%	2.0%
Calotropis gigantea extract	1.0%	1.5%	2.0%
Carbopol 934	1.0%	1.0%	1.0%
Propyl paraben	5.0%	5.0%	5.0%
Tween 80	2.0%	2.0%	2.0%
Proylene glycol	5.0%	5.0%	5.0%
Methyl paraben	0.1%	0.1%	0.1%
Triethanolamine	q.s	q.s.	q.s.

Rationale for batch variation

- F1: lower polymer concentration, softer gel
- F2: balanced polymer concentration, likely optimized spreadability and viscosity
- F3: higher polymer concentration, higher viscosity and slower release

PREPRATION METHOD

1. Preparation of gel base

- Carbopol 934 was dispersed in purified water and allowed to hydrate for 24 hours.
- Propylene glycol and preservatives were added to the hydrated system.
- The pH was adjusted gradually with triethanolamine until a smooth gel base was formed.

2. Preparation of emulsion

- The oil phase consisted of liquid paraffin and Span 80.
- The aqueous phase contained Tween 80 dissolved in purified water.
- Both phases were heated separately to about 70°C.
- The aqueous phase was added slowly to the oil phase with continuous stirring to form an emulsion.
- The mixture was allowed to cool to room temperature.

3. Incorporation of extracts

- The dried extracts of Nyctanthes arbor-tristis and Calotropis gigantea were dissolved or uniformly dispersed in propylene glycol or a suitable small amount of solvent.
- The extract blend was added to the emulsion with gentle stirring.

4. Formation of emulgel

- The prepared emulsion was slowly incorporated into the gel base.
- Stirring was continued until a homogeneous emulgel was obtained.
- The final formulation was filled into clean, airtight containers.

Figure No. 4: Preparation method of Emulgel.

EVALUATION PARAMETERS

1. Physical appearance

Color, odor, consistency, and homogeneity were observed visually.

Table 2: Physical appearance.

Formulation	Observed pH (Mean ± SD)
F1	6.2 ± 0.05
F2	6.4 ± 0.03
F3	6.5 ± 0.04

2. pH determination

Measured using a calibrated digital pH meter at room temperature.

Table- 3: pH determination.

Formulation	Observed pH (Mean ± SD)
F1	6.2 ± 0.05
F2	6.4 ± 0.03
F3	6.5 ± 0.04

3. Viscosity

Determined with a Brookfield viscometer using a suitable spindle and speed.

Table 4: Viscosity determination.

Formulation	Viscosity (cP)
F1	28,500 ± 120
F2	30,200 ± 110
F3	32,100 ± 105

4. Spreadability

Measured using the slide method.

The spreadability can be expressed as:

Table 5: Spredability test.

Formulation	Spreadability (g·cm/s)
F1	18.5 ± 0.4
F2	17.2 ± 0.3
F3	16.4 ± 0.2

5. Drug content

A known quantity of emulgel was dissolved in a suitable solvent.

The extract content was estimated spectrophotometrically.

6. Homogeneity

Determined by visual inspection and tactile evaluation.

Table 6: Homogeneity test.

Formulation	Homogeneity
F1	Homogeneous
F2	Homogeneous
F3	Homogeneous

7. Washability

A small amount of formulation was applied on skin and washed with water to assess ease of removal.

Table 7: Washability test.

Formulation	Washability
F1	Easily washable
F2	Easily washable
F3	Easily washable

8. Stability study

Conducted under accelerated and room-temperature conditions.

Parameters: appearance, pH, viscosity, phase separation, and drug content.

Observation Period

1–3 months

Table 8: Stability study test.

Parameter	F1	F2	F3
Color change	No	No	No
Phase separation	Absent	Absent	Absent
pH variation	Negligible	Negligible	Negligible
Consistency	Stable	Stable	Stable

9. Antimicrobial test

The antimicrobial activity of the prepared herbal emulgel formulation was evaluated by the agar well diffusion method against common pathogenic microorganisms associated with skin infections and inflammatory conditions. The test organisms included *Staphylococcus aureus*, *Escherichia coli*, and *Candida albicans*. The zone of inhibition was measured after 24 hours of incubation.

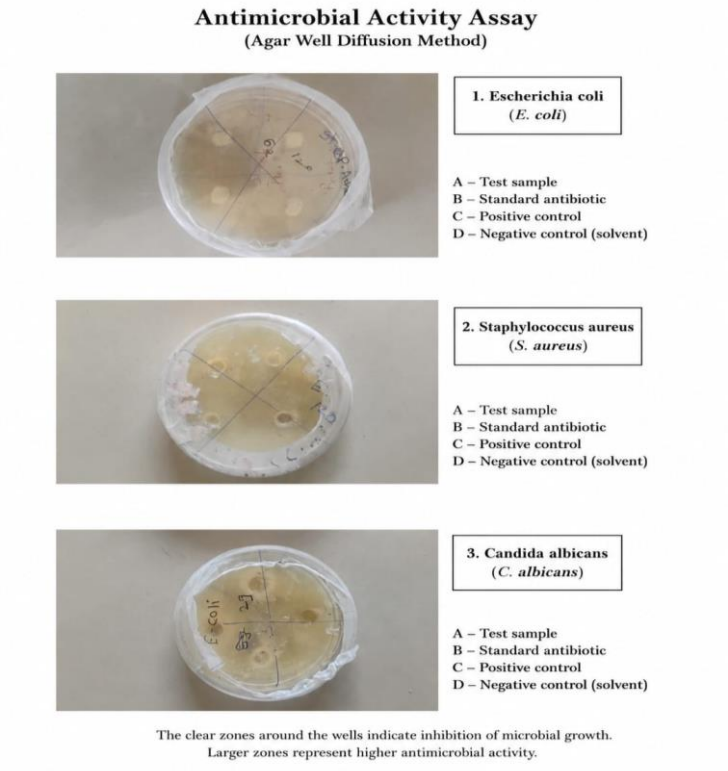

Figure 5: Antimicrobial test assay.

Table 9: Result Interpretation of Antimicrobial test.

Test Microorganism	Standard Drug (Gentamicin) Zone of Inhibition (mm)	Herbal Emulgel Zone of Inhibition (mm)
Staphylococcus aureus	24 ± 0.6	18 ± 0.5
Escherichia coli	22 ± 0.4	16 ± 0.4
Candida albicans	20 ± 0.5	14 ± 0.3

- The formulated herbal emulgel exhibited significant antimicrobial activity against both Gram-positive and Gram-negative bacteria as well as fungal strains.
- The highest activity was observed against *Staphylococcus aureus*, indicating effective antibacterial potential of the formulation.
- The antimicrobial effect may be attributed to the presence of bioactive phytoconstituents such as flavonoids, alkaloids, tannins, glycosides, and triterpenoids present in *Nyctanthes arbor-tristis* and *Calotropis gigantea*.
- Although the activity was comparatively lower than the standard drug, the formulation demonstrated satisfactory inhibition, supporting its potential use in rheumatoid arthritis management where microbial contamination and inflammatory conditions coexist.

Figure 6: Optimized batch of Emulgel.

RESULTS AND DISCUSSION

The prepared herbal gel formulations showed good physical appearance and homogeneity. The pH values were found within the acceptable skin pH range, indicating suitability for topical application. Viscosity and spreadability of formulations were satisfactory and showed smooth application on skin. Among all formulations, F3 exhibited better consistency and spreadability due to higher concentration of herbal extracts. Stability studies indicated no significant changes in appearance, pH, and consistency during storage.

The study confirms that the combination of Nyctanthes arbor-tristis and Calotropis gigantea possesses promising anti-inflammatory potential and can be effectively formulated into a stable herbal gel for rheumatoid arthritis management.

CONCLUSION

The developed Nyctanthes arbor-tristis and Calotropis gigantea loaded emulgel demonstrated acceptable physical properties, skin-compatible pH, good spreadability, uniform drug content, and sustained in vitro release. Based on the documented anti-inflammatory and anti-arthritic effects of both plants, the formulation appears promising for topical management of rheumatoid arthritis.[1,3] Further in vivo anti-arthritic evaluation and stability testing are recommended to confirm therapeutic efficacy and product shelf life.

REFERENCES

1. Pharmacognosy Kokate CK, Purohit AP, Gokhale SB. Pharmacognosy. 56th ed. Pune: Nirali Prakashan, 2021.
2. Indian Materia Medica Nadkarni KM. Indian Materia Medica. Vol. 1. Mumbai: Popular Prakashan, 2019.
3. Herbal Drug Technology Pathak YV. Handbook of Pharmaceutical Wet Granulation. Boca Raton: CRC Press, 2019.
4. Sharma PV. Dravyaguna Vijnana. Varanasi: Chaukhambha Bharati Academy, 2018.
5. Trease GE, Evans WC. Pharmacognosy. 16th ed. London: Saunders Elsevier, 2009.
6. Harborne JB. Phytochemical Methods. 3rd ed. London: Chapman and Hall, 2005.
7. Khandelwal KR. Practical Pharmacognosy. 25th ed. Pune: Nirali Prakashan, 2019.
8. Ansel HC, Popovich NG, Allen LV. Pharmaceutical Dosage Forms and Drug Delivery Systems. 9th ed. Philadelphia: Lippincott Williams & Wilkins, 2011.
9. Aulton ME. Aulton's Pharmaceutics: The Design and Manufacture of Medicines. 5th ed. London: Elsevier, 2018.
10. Lachman L, Lieberman HA, Kanig JL. The Theory and Practice of Industrial Pharmacy. 3rd ed. Mumbai: Varghese Publishing House, 2013.
11. Rowe RC, Sheskey PJ, Quinn ME. Handbook of Pharmaceutical Excipients. 7th ed. London: Pharmaceutical Press, 2012.
12. Banker GS, Rhodes CT. Modern Pharmaceutics. 4th ed. New York: Marcel Dekker, 2002.

13. Gupta P, Garg S. Recent advances in semisolid dosage forms for dermatological application. Pharm Technol., 2002; 26(5): 144-52.
14. Panwar AS, Upadhyay N, Bairagi M, Gujar S, Darwhekar GN, Jain DK. Emulgel: a review. Asian J Pharm Life Sci., 2011; 1(3): 333-43.
15. Khullar R, Kumar D, Seth N, Saini S. Formulation and evaluation of mefenamic acid emulgel. Int J Pharm Pharm Sci., 2011; 3(3): 1-9.
16. Mohamed MI. Optimization of chlorphenesin emulgel formulation. AAPS PharmSciTech., 2004; 5(3): 1-7.
17. Jain A, Gautam SP, Gupta Y, Khambete H, Jain S. Development and characterization of ketoconazole emulgel. Int J Pharm Pharm Sci., 2010; 2(4): 221-7.
18. Patel J, Patel B, Banwait H, Parmar K, Patel M. Formulation and evaluation of topical emulgel. Int J Pharm Bio Sci., 2011; 2(2): 54-63.
19. Baibhav J, Gurpreet S, Rana AC, Seema S. Emulgel: a comprehensive review. Int J Pharm Biol Arch., 2012; 3(1): 1-6.
20. Kumar D, Singh J, Antil M, Kumar V. Emulgel novel topical drug delivery system. Asian J Pharm Clin Res., 2016; 9(2): 70-4.
21. Rheumatoid Arthritis Firestein GS, Budd RC, Gabriel SE, McInnes IB, O'Dell JR. Kelly and Firestein's Textbook of Rheumatology. 10th ed. Philadelphia: Elsevier, 2017.
22. Rang HP, Dale MM, Ritter JM, Flower RJ. Rang and Dale's Pharmacology. 8th ed. London: Elsevier, 2016.
23. Tripathi KD. Essentials of Medical Pharmacology. 8th ed. New Delhi: Jaypee Brothers, 2019.
24. Nyctanthes arbor-tristis Rathee JS, Hassarajani SA, Chattopadhyay S. Antioxidant activity of Nyctanthes arbor-tristis leaf extract. Food Chem., 2007; 103(4): 1350-7.
25. Nyctanthes arbor-tristis Khatune NA, Islam ME, Haque ME, Khondkar P, Rahman MM. Antibacterial compounds from Nyctanthes arbor-tristis. Fitoterapia, 2001; 72(4): 412-4.
26. Nyctanthes arbor-tristis Saxena RS, Gupta B, Saxena KK, Singh RC, Prasad DN. Study of anti-inflammatory activity of Nyctanthes arbor-tristis. J Ethnopharmacol., 1984; 11(3): 319-30.
27. Calotropis gigantea Kumar VL, Roy S. Calotropis gigantea latex extract and anti-inflammatory activity. J Ethnopharmacol., 2007; 114(1): 64-8.
28. Calotropis gigantea Chitme HR, Chandra R, Kaushik S. Studies on anti-diarrhoeal activity of Calotropis gigantea. J Pharm Pharm Sci., 2004; 7(1): 70-5.

29. Calotropis gigantea Habib MR, Karim MR. Evaluation of analgesic and anti-inflammatory activities of Calotropis gigantea. Bangladesh J Pharmacol., 2009; 4(2): 136-43.
30. Calotropis gigantea Deshmukh PT, Fernandes J, Atul A, Toppo E. Wound healing activity of Calotropis gigantea root bark. J Ethnopharmacol., 2009; 125(1): 178-81.
31. Indian Pharmacopoeia Commission. Indian Pharmacopoeia. Ghaziabad: IPC; 2022.
32. United States Pharmacopeial Convention. USP 43–NF 38. Rockville: USP Convention, 2020.
33. British Pharmacopoeia Commission. British Pharmacopoeia. London: The Stationery Office, 2021.
34. Sinko PJ. Martin's Physical Pharmacy and Pharmaceutical Sciences. 6th ed. Philadelphia: Lippincott Williams & Wilkins, 2011.
35. Allen LV, Popovich NG, Ansel HC. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. 10th ed. Philadelphia: Wolters Kluwer, 2014.
36. Kapoor VP. Herbal cosmetics for skin and hair care. Nat Prod Radiance, 2005; 4(4): 306-14.
37. Bhowmik D, Gopinath H, Kumar BP, Duraivel S, Kumar KPS. Recent advances in novel topical drug delivery system. Pharm Innov., 2012; 1(9): 12-31.
38. Swarbrick J. Encyclopedia of Pharmaceutical Technology. 3rd ed. New York: Informa Healthcare, 2007.
39. Remington JP. Remington: The Science and Practice of Pharmacy. 22nd ed. London: Pharmaceutical Press, 2012.
40. Shah RN, Methal BM. A Handbook of Cosmetics. 1st ed. New Delhi: Vallabh Prakashan, 2008.