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FORMULATION AND EVALUATION OF POLYHERBAL EMULGEL FOR RHEUMATOID ARTHRITIS

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ABSTRACT

Rheumatoid arthritis is a chronic inflammatory autoimmune disorder characterized by joint pain, swelling, stiffness, and progressive functional impairment, necessitating safer and more effective therapeutic approaches. The present study focuses on the formulation and evaluation of a polyherbal emulgel for the topical management of rheumatoid arthritis, aiming to enhance therapeutic efficacy while minimizing systemic side effects. The emulgel was formulated using ethanolic extracts of Rubia cordifolia, Vitex negundo, Piper nigrum, and Myristica fragrans, selected for their well-documented anti-inflammatory, analgesic, and antioxidant properties. The formulation combined the advantages of emulsions and gels to improve drug penetration and patient compliance. Various formulations were prepared using Carbopol 940 as a gelling agent and evaluated for physicochemical parameters including pH, viscosity, spreadability, extrudability, drug content, and in vitro drug release. All formulations exhibited acceptable characteristics suitable for topical application. Among them, formulation F3 demonstrated optimal performance with ideal viscosity, superior spreadability, uniform drug content (98.6%), and maximum drug release (89%) over 8 hours, along with good stability. The findings suggest that the developed polyherbal emulgel is a promising and effective alternative for the topical treatment of rheumatoid arthritis, offering sustained release, enhanced penetration, and improved patient compliance.

***Keywords*:** Polyherbal emulgel; Rheumatoid arthritis; Topical drug delivery; Anti-inflammatory; In vitro drug release.

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INTRODUCTION

Inflammatory disorders constitute a major group of chronic diseases affecting millions of people worldwide, significantly impairing quality of life and productivity [1]. Among these, Rheumatoid arthritis is a systemic, chronic, autoinflammatory disorders primarily affecting synovial joints and leading to progressive joint destruction, pain, stiffness, swelling, and functional disability. The disease not only involves joints but may also affect extra-articular organs such as skin, lungs, heart and eyes. Despite advances in pharmacotherapy, Rheumatoid arthritis remains a therapeutic challenge, due to its chronic nature, multifactorial pathogenesis, adverse effects of long-term drug therapy, and variable patient response [2].

Herbal medicines have been traditionally used to manage inflammatory disorders due to their anti-inflammatory, analgesics, antioxidant, and immunomodulatory properties. Medicinal plants contain bioactive phytoconstituents such as flavonoids, alkaloids, tannins, saponins, terpenoids, and phenolic compounds that contribute to therapeutic effects [3]. Polyherbal formulations are based on the principle that combining multiple herbs enhances therapeutic efficacy through synergism while minimizing toxicity. Many herbal drugs like *Rubia cordifolia, Vitex negundo, Piper nigrum, Myristica fragrans* have demonstrated significant anti-arthritic activity in experimental and clinical studies [4]. Emulgel facilitate deeper penetration of active constituents into inflamed tissues, providing sustained anti-inflammatory and analgesic effects while minimizing systemic absorption and adverse effects [5]. The present study is to formulate and evaluate a polyherbal emulgel containing selected herbal extracts with anti-inflammatory and anti arthritic properties for

the effective topical management enhances drug penetration and therapeutic efficacy

MATERIALS AND METHODS

Formulation of polyherbal emulgel

The study was designed to formulate and evaluate a polyherbal emulgel for the management of rheumatoid arthritis. The polyherbal emulgel was formulated using a structured and reproducible approach integrating herbal extraction, emulsion preparation, and gel incorporation. Selected medicinal plants, namely *Rubia cordifolia*, *Vitex negundo*, *Piper nigrum*, and *Myristica fragrans*, were shade-dried, coarsely powdered, and subjected to maceration with 70% ethanol for 48 hours. The extracts were filtered and concentrated under controlled temperature (<50°C) to obtain semisolid residues, which were combined in equal proportions. A gel base was prepared by dispersing Carbopol 940 in purified water with continuous stirring, followed by hydration for 24 hours and neutralization using triethanolamine to achieve a pH of 6–6.5, forming a clear, stable gel matrix. In parallel, an oil-in-water emulsion was developed by dissolving oil-phase components (including Span 20 and lipophilic constituents) and aqueous-phase components (Tween 20, methyl and propyl parabens, and propylene glycol) separately, followed by heating both phases to a uniform temperature and homogenizing them under continuous stirring to ensure emulsion stability. The final emulgel was obtained by gradual incorporation of the prepared emulsion into the gel base with gentle mixing to achieve uniform distribution, optimal viscosity, and enhanced stability, rendering the formulation suitable for effective topical delivery in inflammatory conditions [6].

Table 1: Composition of polyherbal emulgel

Ingredients	F1	F2	F3	F4	F5	F6
Carbopol 940 (g)	–	–	–	1.5	3	4.5
RVMP Extract	3	3	3	3	3	3
Tween20	1.5	1.5	1.5	1.5	1.5	1.5
liquid paraffin	15	15	15	15	15	15
Propylene glycol	15	15	15	15	15	15
Methyl paraben	0.06	0.06	0.06	0.06	0.06	0.06
Propyl paraben	0.03	0.03	0.03	0.03	0.03	0.03
Triethanolamine	q.s	q.s	q.s	q.s	q.s	q.s
Purified water	q.s	q.s	q.s	q.s	q.s	q.s

Evaluation of polyherbal emulgel

i. Physical Appearance

The formulated polyherbal emulgel was visually inspected for color, homogeneity, consistency, and phase separation. The formulation was observed to be smooth, uniform, and free from any lumps or grittiness, indicating proper mixing and stability [7].

ii. pH Determination

The pH of the emulgel was measured using a calibrated digital pH meter. Approximately 1 g of formulation was dispersed in distilled water and evaluated to ensure skin compatibility. The pH was maintained within the range of 6–6.5, which is suitable for topical application without causing irritation [7].

iii. Homogeneity

A small quantity of gel was pressed between thumb and index finger to check for uniformity and absence of lumps [8].

iv. Viscosity

Viscosity of the prepared emulgel was determined using a Brookfield viscometer at appropriate spindle speed. This parameter was evaluated to ensure optimum consistency, ease of application, and stability of the formulation [9].

v. Spreadability

Spreadability was determined by the slip and drag method using two glass slides. A known weight of emulgel was placed between the slides, and the time required for the slides to separate under a specified load was recorded. Good spreadability indicates ease of application on the skin [10].

vi. Extrudability

Extrudability was evaluated by measuring the force required to extrude the formulation from a collapsible tube. The amount of emulgel extruded in a given time was noted, indicating the formulation's applicability and user convenience [11].

vii. Estimation of Drug Content

Drug content was determined by dissolving a known quantity of emulgel in a suitable solvent followed by filtration. The solution was analyzed spectrophotometrically to ensure uniform distribution

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of active herbal constituents within the formulation [12].

RESULTS AND DISCUSSION

The present study was undertaken to formulate and evaluate a polyherbal emulgel for the topical management of rheumatoid arthritis. The formulation was prepared using selected herbal extracts known for their anti-inflammatory and analgesic properties, including *Rubia cordifolia, Vitex negundo, Myristica fragrans,* and *Piper nigrum.*

The emulgel system was selected as a suitable topical drug delivery system because it combines the advantages of both emulsions and gels. Emulgel provide better drug penetration, improved stability, non-greasy texture, and enhanced patient compliance when compared to conventional ointments and creams. All prepared formulations (F1–F4) were evaluated for various physicochemical parameters.

i. Physical Appearance

All formulated batches (F1–F4) of polyherbal emulgel were evaluated for physical characteristics. All formulations showed acceptable physical appearance without any instability. The physical examination revealed that all batches were smooth, homogeneous, and free from grittiness and phase separation, indicating proper formulation compatibility of ingredients. The characteristic greenish-brown colour was due to the presence of herbal extracts.

ii. pH Determination

All formulations were within acceptable skin pH range. The results are given in table 2.

Table 2: pH values of polyherbal emulgel

Formulation	pH (Mean±SD)
F1	6.4±0.02
F2	6.6±0.01
F3	6.8±0.03
F4	6.5±0.02

iii. Viscosity

The pH of all formulations was found to be within the acceptable skin range (5.5–7), suggesting that the prepared emulgel is safe for topical application and unlikely to cause irritation. F3 showed comparatively higher viscosity. Viscosity studies indicated that the formulations possessed suitable consistency for topical application. An optimum viscosity is essential to ensure proper retention of the formulation at the site of application without affecting spread ability. Among all batches, formulation F3 showed ideal viscosity.

Table 3: Viscosity of polyherbal emulgel

Formulation	Viscosity (CPs)
F1	18,500
F2	21,200
F3	24,100
F4	19,800

iv. Spreadability

Spread ability is an important parameter for patient acceptability. The results demonstrated that all formulations exhibited good spread ability, ensuring easy application on the affected area. Formulation F3 showed comparatively better spreading characteristics. F3 exhibited maximum spreadability.

Table 4: Spreadability of polyherbal emulgel

Formulation	Spreadability (gcm/sec)
F1	14.2
F2	15.8
F3	17.4
F4	15.1

v. Drug Content

Drug content analysis confirmed uniform distribution of herbal extracts within the formulation, with values falling within acceptable limits (95–105%). This indicates proper mixing and homogeneity of the prepared emulgel. All batches showed uniform drug distribution within acceptable limits.

Table 5: Drug content of polyherbal emulgel

Formulation	%Drug Content
F1	95.4%
F2	97.2%
F3	98.6%
F4	96.8%

vi. In-Vitro Drug Release (8 hours)

In-vitro drug release studies revealed sustained release of active constituents over a period of 8 hours. Formulation F3 exhibited maximum drug release, which may be attributed to the optimized concentration of gelling agent and proper emulsification. The presence of Piper nigrum may enhance bioavailability due to piperine, thereby improving the therapeutic effect Maximum drug release was observed in formulation F3.

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Table 6: In-Vitro Drug Release of polyherbal emulgel

Formulation	% Drug Release
F1	82%
F2	85%
F3	89%
F4	84%

vii. Extrudability

All formulations showed good extrudability from aluminium collapsible tubes with smooth flow.

viii. Stability Studies (3 Months)

Stability studies conducted under different storage conditions showed no significant change in colour, pH, drug content, or phase separation. This confirms that the prepared formulation is stable and suitable for storage. No significant change in colour, no phase separation, slight variation in pH (within acceptable limits), drug content remained above 95%, F3 was found to be stable under both room temperature and accelerated conditions.

Among all the prepared batches, formulation F3 was selected as the optimized formulation based on better physicochemical properties, maximum drug release, and good stability profile. Overall, among all prepared batches, formulation F3 was considered as the optimized formulation based on its superior physicochemical properties, maximum drug release, and stability profile. Formulated polyherbal emulgel demonstrated satisfactory evaluation parameters and sustained drug release, indicating its potential effectiveness in the topical management of rheumatoid arthritis.

CONCLUSION

The present study was successfully carried out to formulate and evaluate a polyherbal emulgel for the topical management of rheumatoid arthritis. The emulgel was prepared using selected herbal extracts such as Rubia cordifolia, Vitex negundo, Myristica fragrans, and Piper nigrum, which are known for their anti-inflammatory, analgesic, and antioxidant properties The formulated polyherbal emulgel was evaluated for various physicochemical parameters including physical appearance, pH, viscosity, spreadability, drug content, in-vitro drug release, extrudability, and stability studies. All formulations showed satisfactory results within acceptable limits for topical application. Among the prepared batches, formulation F3 was found to be the optimized formulation based on ideal pH, suitable viscosity, better spreadability, uniform drug content, maximum drug release, and good stability profile. The study confirms that the polyherbal emulgel system is a promising and effective topical drug delivery approach for the management of rheumatoid arthritis. The combination of selected herbal extracts may provide synergistic therapeutic effects with improved patient compliance and reduced side effects compared to conventional formulations.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Kute SB, Saudagar RB. Emulsified gel: A novel approach for topical drug delivery. J Adv Pharm Educ Res. 2013;3(4):368–376.
2. Vrushika R. Khairnar, Vipul P. Patel, and Laxman P. Gorde. Comparative quality evaluation of marketed formulation of diclofenac diethylamine gel. International Journal of Pharmaceutics and Drug Analysis, vol. 5, no. 6, June 2017, pp. 204-11.
3. Valecha SG, et al. Emulgel: A novel approach for topical drug delivery – A review. Asian Journal of Pharmacy and Technology. 2023;13(4): 287–294.
4. Khullar R, Kumar D, Seth N, Saini S. Formulation and evaluation of mefenamic acid emulgel for topical delivery. Saudi Pharm J. 2012;20(1):63–67.
5. Shrikhande PV, et al. Formulation and evaluation of polyherbal topical anti-inflammatory emulgel. Research Journal of Pharmacy and Technology. 2013;6(1): 52–56.
6. Khare B. Polyherbal formulations in rheumatoid arthritis: A review. Journal of Applied Science and Research. 2022;10(2): 45–52.
7. Patel J, Patel B. Formulation and evaluation of topical emulgel. International Journal of Universal Pharmacy and Bio Sciences. 2013;2(2): 585–598.
8. Archana GL, K. Srisailam, M. Nagulu. Formulation Optimisation and Evaluation of a Turmeric Extract–Incorporated Emulgel Using a Simplex Lattice Approach". International Journal of Pharmaceutics and Drug Analysis, , 2026; 14:11-8.
9. Usmania, Ajay Bilandi, and Mahesh K. Kataria. "Minoxidil Emulgel for Androgenic Alopecia: A Literature Review Including Patents". International Journal of Pharmaceutics and Drug Analysis, 2016;5(3):49-58.
10. Badri. Sireesha, D. Smily, J. Akhila et al. Formulation and evaluation of antiarthritic herbal chocolate: a review. World Journal of Current Med and Pharm Research. 2025;7(3): 21-28.
11. Manjanna K, Veeran Gouda B, Tanusha AS, Ankita S, Anusha H, Arpita J. Formulation and Evaluation of Capsaicin Transemulgel for the Treatment of Arthritis. J. Drug Delivery Ther. 2025;15(1):73-8.
12. Patil SA, Sarode S, Sathe BS, Jain PV, Jain BV, Vadnere GP. Formulation and evaluation of etodolac trans-emulgel. World J Pharm Pharm Sci. 2014 May 6;3:1731-49.