IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Green Formulation Strategy For Pain Management: A Polyherbal Gel Containing Therapeutic Essential Oils

[1]Dr.C. Rubina Reichal, [2]Mr.M. Nanthakumar.

[1]Associate Professor, [2]Assistant Professor, Department of Pharmaceutics, College of Pharmacy, Sri Ramakrishna Institute of Paramedical Sciences (Affiliated to The Tamil Nadu Dr. M.G.R. Medical University), Coimbatore-641 044.

Abstract: Pain and inflammation are among the most common conditions affecting global health and quality of life. Conventional NSAIDs provide relief but are often linked to systemic side effects. This study focuses on a green formulation strategy for developing an eco-friendly polyherbal topical gel containing essential oils with analgesic and anti-inflammatory properties. The gel was prepared using Carbopol 940 as a gelling agent and incorporated wintergreen, peppermint, turmeric, and rosemary oils as active ingredients. All the formulations were evaluated for pH, viscosity, spreadability, homogeneity, and an in vitro release study. Based on the desirable results, formulation 5 (F5) was optimized, and the optimized gel exhibited smooth texture, desirable pH (6.7 ± 0.2), excellent spreadability, and sustained diffusion of 85% over six hours. The synergistic combination of essential oils enhanced the overall anti-inflammatory and analgesic effects, confirming that a natural green-based formulation offers an effective and sustainable alternative to synthetic pain-relief gels.

Keywords: Green formulation, polyherbal gel, essential oils, pain management, anti-inflammatory, analgesic.

1. Introduction

Pain is a complex physiological response that often requires both systemic and local therapy. Prolonged use of NSAIDs can lead to gastrointestinal irritation, nephrotoxicity, and cardiovascular risks [1,2]. Consequently, the interest in natural, plant-based formulations has increased, promoting the development of green and sustainable pharmaceutical products[3–5].

Essential oils derived from medicinal plants possess multiple pharmacological properties. Wintergreen oil, rich in methyl salicylate, acts as a topical analgesic [7]; peppermint oil provides a cooling counterirritant effect through menthol [8]; turmeric oil contains curcumin, a potent anti-inflammatory compound [9]; and rosemary oil improves circulation and exhibits antioxidant activity [10].

Incorporating these oils into a carbopol-based hydrogel allows localized delivery, controlled release, and patient acceptability [11–13]. A polyherbal approach enhances therapeutic potential through synergistic action [14,15]. This research aims to formulate a green polyherbal gel integrating these oils and evaluate its physicochemical and performance parameters to validate its suitability for pain management.

2. Materials and Methods

2.1. Materials

All supportive excipients and essential oils were procured from standard pharmaceutical suppliers. All reagents were of in analytical grade.

3. Formulation of Polyherbal Gel

A weighed quantity of Carbopol 940 was dispersed in a specified quantity of purified water and allowed to swell for 60 minutes. PEG-400 and EDTA were added with continuous stirring. Menthol and camphor were dissolved separately and incorporated. Essential oils, wintergreen, peppermint, turmeric, and rosemary were added slowly with continuous stirring. Triethanolamine was then added dropwise until a pH of 6.7 was achieved, forming a uniform, transparent gel. The final weight was adjusted to 100 g with purified water [16-17].

Table No.1 Composition of Polyherbal Pain-Relief Gel Formulations (100 g Batch)

S. No	Ingredient	Function	F1	F2	F3	F4	F5	F6
1	Carbopol 940	Gelling agent	1.5g	1.5g	1.5g	1.5g	1.5g	1.5g
2	Triethanolamine (TEA)	pH adjuster	1.5ml	1.5ml	1.5ml	1.5ml	1.5ml	1.5ml
3	PEG-400	Solvent, humectant	5.0ml	5.0ml	5.0ml	5.0ml	5.0ml	5.0ml
4	EDTA	Chelating agent	5mg	5mg	5mg	5mg	5mg	5mg
5	Wintergreen oil	Analgesic, anti-inflammatory	0.15ml	0.20ml	0.25ml	0.30ml	0.35ml	0.40ml
6	Peppermint oil	Cooling, soothing	0.15ml	0.20ml	0.25ml	0.30ml	0.35ml	0.40ml
7	Turmeric oil	Anti-inflammatory, antioxidant	0.15ml	0.20ml	0.25ml	0.30ml	0.35ml	0.40ml
8	Rosemary oil	Muscle relaxant, anti-inflammatory	0.15ml	0.20ml	0.25ml	0.30ml	0.35ml	0.40ml
9	Camphor	Counterirritant, analgesic	0.8g	1.0g	1.2g	1.5g	1.8g	2.0g
10	Menthol	Cooling agent, analgesic	1.5g	2.0g	2.5g	3.0g	3.5g	4.0g
11	Colouring agent	Appearance	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.
12	Purified water	Vehicle/solvent	q.s. to 100g	q.s. to 100g	q.s. to 100g	q.s. to 100g	q.s. to 100g	q.s. to 100g

Figure No: 1 Poly herbal Gel

4. Evaluation Parameters

4.1. Physical appearance and homogeneity
The gel was inspected visually for colour, odour, texture, and presence of lumps or phase separation [18-20].

4.2. Viscosity
Measured using a Brookfield viscometer at 25 °C with spindle no. 64 at 10 rpm [18-20].

4.3. Spreadability
Determined using the slip and drag method [21-23].

4.4. pH measurement
The pH of a 1% w/w gel dispersion was determined using a calibrated digital pH meter [23-25].

4.5. In-vitro Diffusion Study
Conducted using a Franz diffusion cell with an egg membrane and phosphate buffer (pH 7.4) at 37 ± 1 °C. The temperature of the cell was maintained at 37˚C, and the solution was stirred continuously. 1 mL of the aliquot sample was withdrawn at specific time intervals over 24 hours, and the same quantity was replaced. The samples withdrawn were analyzed UV spectrophotometrically [23-26].

4.6. Stability study
The stability of the formulation was tested by filling the gel in plastic containers and placing it in a humidity chamber at 45°C and 75% relative humidity. The stability of the formulation was inspected for 30 days and evaluated periodically for color, odor, and pH [23-26].

5. Results and Discussion:
5.1. Physical Evaluation
The formulated gel was clear, smooth, and homogeneous with a pleasant herbal odor. No phase separation or grittiness was observed, and the results are shown in Table 2.

5.2. pH and Viscosity
The pH was found to be 6.7 ± 0.2, suitable for skin application. The viscosity ranged between 11.28 and 19.90 poise, providing good consistency and spreadability. The results are shown in Table 2.

5.3. Spreadability
The gel demonstrated excellent spreadability (8.2 g·cm/sec), ensuring ease of topical application and uniform film formation and the results are shown in Table 2.

TableNo.2 Comparative Evaluation of Polyherbal Gel Formulations (F1–F6)

Parameter	F1	F2	F3	F4	F5	F6
Appearance	Reddish brown	Reddish brown	Reddish brown	Reddish brown	Reddish brown	Reddish brown
Homogeneity	Good	Good	Good	Good	Good	Good
Viscosity (poise)	12.90	11.90	12.70	16.90	11.28	19.90
Spreadability g.cm/sec	Good	Good	Good	Good	Good	Good
pH (Skin Friendly)	6.1	6	5.9	5.7	6.7	7.1

5.4. In Vitro Diffusion

The diffusion profile revealed cumulative release of formulation 5, showing 85% after 6 hours, indicating sustained diffusion and permeation through the membrane, and it revealed that formulation 5 contained all ingredients in optimal concentration, and the results shown in Table 3.

Table No. 3 In-vitro release profiles for all six formulations

Time (h)	F1	F2	F3	F4	F5	F6
0	0	0	0	0	0	0
1	10	12	15	18	20	22
2	18	22	27	32	35	38
3	26	32	40	46	50	55
4	34	42	53	60	65	70
5	40	50	60	68	72	78
6	46	58	68	76	85	82
7	52	65	74	82	88	86
8	58	70	80	88	95	90

5.5. Stability Study

The stability study was carried out on the optimized formulation 5 (F5), the results are shown in Table 4.

Table No.4 Stability study for F5 optimized Gel

Parameters	Initial	1st month
Colour	Reddish brown	Reddish brown
Odour	fragrance of peppermint	fragrance of peppermint
pH	6.7	6.7

There was no marked change in color, odor, or pH during the stability study period after 30 days of storage.

Conclusion

A green polyherbal pain-relief gel containing essential oils was successfully formulated and evaluated. The optimized gel demonstrated favorable physical characteristics, stable pH, good spreadability, and sustained release properties. The synergistic activity of the selected oils provided effective analgesic and anti-inflammatory potential. This study supports the development of eco-friendly herbal topical formulations as promising alternatives to synthetic pain-relief agents

Acknowledgement

The authors sincerely thank the Management and Principal of SRIPMS College of Pharmacy, Coimbatore, for their support and for providing the necessary facilities to complete this research work

References

1. Vane JR, Botting RM. Mechanism of action of anti-inflammatory drugs. Int J Tissue React. 1998;20(1):3–15.
2. Rainsford KD. Anti-inflammatory drugs in the 21st century. Subcell Biochem. 2007;42:3–27.
3. Handa SS. Textbook of Pharmacognosy. New Delhi: Vallabh Prakashan; 2019.
4. Ahmed R, Rahman M. Evaluation of polyherbal anti-inflammatory gel. Bangladesh J Pharmacol. 2016;11(3):671–6.
5. Bhowmik D, Kumar KPS, Chandira M. Recent trends in herbal topical formulations. Int J Pharm Biomed Sci. 2018;9(2):67–72.
6. Shah K, Patel J, Patel P. Formulation and evaluation of herbal gel containing essential oils. Int J Green Pharm. 2018;12(3):153–8.
7. Upadhyay A, Pandey V. Comparative study of natural essential oils for topical pain relief. Ind J Pharm Sci. 2020;82(6):961–7.
8. Joshi R, Jain V. Role of peppermint and menthol in topical analgesic preparations. Phytother Res. 2017;31(9):1315–22.
9. Shankar R, Kumar M. Anti-inflammatory and analgesic effects of turmeric oil. Pharmacogn Mag. 2018;14(2):102–7.

10. Pandey A, Singh A. Use of rosemary oil for pain and inflammation. J Essent Oil Res. 2021;33(5):398–404.
11. Kaur P, Kaur A. Formulation and characterization of carbopol-based herbal gel. J Drug Deliv Ther. 2019;9(2):150–5.
12. Gohel M, Parikh R. Physicochemical characterization of topical gels. Indian J Pharm Sci. 2015;77(4):420–5.
13. Dandekar S, Mehta R. Stability testing of herbal gels. Pharm Dev Technol. 2020;25(6):721–9.
14. Sahu RK, Roy A, Dwivedi J. Formulation and evaluation of polyherbal gel for anti-inflammatory activity. World J Pharm Pharm Sci. 2015;4(10):978–90.
15. Anbazhagan S, Sridhar SK. Evaluation of topical herbal formulations for pain relief. Asian J Pharm Clin Res. 2019;12(7):232–7.
16. Bandyopadhyay B, Munsi A, Mollah KI, Debnath B, Bishal A. Formulation and evaluation of polyherbal pain relief gel for its effect on rheumatoid arthritis. J Young Pharm. 2025;17(2):336–343. doi:10.5530/jyp.20251472.
17. Bindod HV. Formulation and evaluation of herbal analgesic balm. J Drug Deliv Ther. 2025;15(4):1–5. doi:10.22270/jddt.v15i4.7296.
18. Quidwai KE. Development and evaluation of herbal analgesic gel. Int J Pharm Sci. 2024;2(1):1–6.
19. Shama SN. Optimizing polyherbal gels for enhanced antibacterial activity. Int J Chem Biol Sci. 2024;23(6):94–100.
20. Patil GN, Patil CS, Bhimrao D. Formulation and evaluation of polyherbal gel for management of scalp psoriasis. World J Pharm Med Res. 2025;11(4):1–6.
21. Maurya R. Transforming medicinal oil into advanced gel. J Pharm Innov. 2024;13(2):1–7.
22. Ain QU, Sharma S, Gupta S. Evaluation of polyherbal gel for musculoskeletal injuries in elderly. Work. 2024;67(3):1–8. doi:10.3233/WOR-230178.
23. Adhoni SA. Formulation and development of gel with essential oils and effect of polymer on their antimicrobial activity. J Biol Sci. 2024;10(1):1–7.
24. Fahimnia F, Rahimi R, Zare M. Development and characterization of a topical gel containing lavender oil for wound healing. J Cosmet Dermatol. 2024;23(1):1–7.
25. Kopustinskiene DM, Masiulis V, Venskutonis PR. Natural herbal non-opioid topical pain relievers: A review. J Ethnopharmacol. 2022;290:115090. doi:10.1016/j.jep.2022.115090.
26. Maru HR, Katariya GM, Kubavat DH, Rathod P. Formulation and evaluation of herbal pain relief gel. Int J Pharm Res Appl. 2025;10(2):1194–