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Design and Development of Poly Herbal Analgesic Liniment for Effective Pain Relief in Arthritis

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Abstract - Arthritis is a chronic inflammatory disorder characterized by pain, swelling, stiffness, and reduced mobility of joints. Conventional analgesic therapies often produce adverse effects upon prolonged use. The present study aimed to formulate and evaluate a polyherbal analgesic liniment containing coconut oil, eucalyptus oil, Vitex negundo oil, clove oil, menthol, camphor, methyl salicylate, beeswax, sodium benzoate, and isopropyl alcohol for effective pain relief in arthritis. Various formulations were prepared using different concentrations of herbal oils and evaluated for physicochemical parameters such as appearance, pH, viscosity, spreadability, phase separation, washability, permeation flux, and accelerated stability studies. The optimized formulation exhibited acceptable physicochemical characteristics, good stability, excellent spreadability, and enhanced permeation properties. The synergistic action of herbal ingredients contributed to significant analgesic and anti-inflammatory activity. The study concludes that the developed polyherbal liniment may serve as a safe, stable, and effective alternative for the management of arthritis-associated pain and inflammation.

Keywords: Polyherbal Liniment, Arthritis, Analgesic, Anti-inflammatory, Topical Drug Delivery, Vitex negundo, Clove Oil.

INTRODUCTION

Arthritis is among the most common musculoskeletal disorders affecting millions of individuals worldwide. It is characterized by inflammation of joints, resulting in pain, swelling, stiffness, and decreased physical function. Long-term administration of oral non-steroidal anti-inflammatory drugs (NSAIDs) is associated with gastrointestinal, cardiovascular, and renal adverse effects.

Topical drug delivery systems have gained considerable attention because they provide localized therapeutic effects, reduce systemic exposure, and improve patient compliance. Herbal medicines have been widely used in traditional systems of medicine due to their safety, affordability, and therapeutic efficacy.

Polyherbal formulations combine multiple medicinal plants to achieve synergistic therapeutic effects. Coconut oil, eucalyptus oil, Vitex negundo oil, clove oil, menthol, camphor, and methyl salicylate possess significant analgesic, anti-inflammatory, counter-irritant, and penetration-enhancing properties, making them suitable candidates for developing an effective topical liniment for arthritis management.

Herbal medicines have been used for centuries in traditional systems of medicine such as Ayurveda for the treatment of pain, inflammation, and musculoskeletal disorders. Polyherbal formulations, which combine two or more medicinal plants, are believed to provide synergistic therapeutic effects, improved efficacy, and reduced toxicity compared with single-herb preparations. The use of multiple herbs with complementary pharmacological activities enhances analgesic and anti-inflammatory responses while minimizing adverse effects.

Topical drug delivery systems have gained considerable attention for the management of arthritis because they deliver the active ingredients directly to the affected site, producing localized therapeutic action while reducing

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systemic exposure and associated side effects. Among topical dosage forms, liniments are liquid or semi-liquid preparations intended for external application with gentle rubbing over the skin. They are easy to apply, spread uniformly, penetrate effectively into superficial tissues, and provide rapid relief from pain and inflammation.

The present study focuses on the design and development of a polyherbal analgesic liniment containing coconut oil as the base along with eucalyptus oil, Vitex negundo oil, clove oil, menthol, camphor, and beeswax. These ingredients have been selected based on their reported analgesic, anti-inflammatory, counter-irritant, antimicrobial, and penetration-enhancing properties. The combined action of these herbal constituents is expected to provide effective relief from arthritic pain, improve joint mobility, and reduce inflammation.

The developed formulation will be evaluated for its physicochemical characteristics, including appearance, pH, viscosity, spreadability, solubility, stability, and in vitro drug permeation, to ensure its quality, safety, and therapeutic performance. The study aims to develop a stable, effective, patient-friendly, and economical polyherbal liniment that may serve as a promising alternative for the topical management of arthritis.

MATERIALS AND METHODS

Materials

The formulation consisted of:

Table No. 1 Material used in the Formulation

S.No.	Material	Functions
1	Coconut oil	Base oil
2	Eucalyptus oil	Pain reliever, aroma
3	Vitex negundo oil	Relieves arthritic pain
4	Clove oil	Relieve pain and inflammation
5	Bees wax	Thickening and emulsifying agent
6	Menthol	Cooling agent, reduces pain & inflammation
7	Camphor	Relives cough and pain
8	Methyl salicylate	Analgesic & counterirritant
9	Sodium benzoate	Preservative
10	Isopropyl alcohol	Solvent

Preparation of Polyherbal Analgesic Liniment

1.Melting Base: The required quantity of bees wax and coconut oil was taken in a clean stainless steel vessel.

2.Heating was done using double boiler until the bees wax melts completely and mixes uniformly with coconut oil.

3.Incorporation of Herbal Oils: Vitex negundo oil, Eucalyptus oil and clove oil were added to the warm mixture.

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4.Stirring was done continuously to ensure proper blending of all oils.

5.Cooling Stage: The vessel removed from heat and allow the mixture to cool slightly (to about 45–50°C) — this prevents volatilization of essential oils and menthol.

6. Addition of Volatile Components: Menthol, Camphor, and Methyl salicylate were added while stirring gently until they dissolve completely in the base.

7.Preservative Addition: Sodium benzoate was dissolved in a few drops of warm water or alcohol (if needed) & was mix thoroughly.

8. Stirring was done continuously until a uniform semisolid consistency was achieved. Ensure no separation of oils or undissolved solids.

9.Filling and Cooling:while still warm , Polyherbal liniment was stored into clean, dry containers. Was Allowd to cool and solidify at room temperature.

10.Labeling & Storage:Once solidified, containers were labeled with product name, batch number, and manufacturing details. Stored in a cool, dry place away from direct sunlight.

Formulation of Liniment in Three Batches.

Table No. 2 Formulation table

S.No.	Ingredients	Batch F1	Batch F2	Batch F3
1	Coconut oil	18ml	15ml	12ml
2	Eucalyptus oil	4ml	5ml	6ml
3	Vitex negundo oil	8ml	10ml	12ml
4	Clove oil	1ml	2ml	3ml
5	Bees wax	0.5g	0.8g	1g
6	menthol	1g	1.5g	2g
7	Camphor	1g	1.5g	2g
8	Methyl salicylate	2ml	3ml	4ml
9	Sodium benzoate	0.05g	0.1g	0.15g
10	Isopropyl alcohol	10ml	10ml	10ml
11	Purified water	q.s.to50 ml	q.s.to50 ml	q.s.to50 ml

• F1 – Optimized medium concentration formulation

• F2 – High concentration formulation

• F3 – Low concentration formulation

Evaluation Parameters

pH Determination Test:-

Procedure

1. The pH meter was calibrated using standard buffer solutions of pH 4.0, 7.0, and 9.2.

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2. One milliliter (1 mL) of the liniment was taken and diluted with 9 mL of distilled water (1:10 dilution).

3. The mixture was stirred thoroughly to obtain a uniform dispersion.

4. The pH meter electrode was immersed into the diluted sample.

5.The reading was allowed to stabilize, and the pH value was recorded.

Phase Separation test :-

1. The prepared liniment was filled into a clean, airtight container.

2. The samples were stored at room temperature and under accelerated temperature conditions.

3. The formulation was observed at regular intervals for any: Procedure

• Layer formation

• Oil separation

• Precipitation

• Change in appearance

4. The observations were recorded.

5. The absence of phase separation indicated good physical stability of the liniment..

Viscosity Determination Test:-

Procedure

1. Approximately 5-10 mL of the liniment was transferred into a clean beaker.

2. The sample was maintained at 25 ± 1°C.

3. A suitable spindle was selected and attached to the Brookfield viscometer.

4. The spindle was immersed in the sample up to the marked level.

5. The viscometer was set to the desired rotational speed (e.g., 50 rpm).

6. The reading was allowed to stabilize for 1-2 minutes.

7. The viscosity value displayed on the instrument was recorded in centipoise (cP)

Spreadability Test :-

• The spreadability of the liniment was measured to determine how easily it spread on the skin.

• Good spreadability improved patient compliance and ensured uniform application.

Formula

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

Where: S = Spreadability

M = Weight tied to upper slide

L = Length moved by glass slide

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T= Time taken

Accelerated stability study test :-

An accelerated stability study is performed to evaluate the stability of the polyherbal analgesic liniment under elevated temperature and humidity conditions in a short period of time.

Procedure

1. The prepared liniment was filled into airtight containers.

2. The samples were stored under accelerated conditions:

- Temperature: 40°C ± 2°C
- Relative humidity: 75% ± 5% RH

3. The samples were kept for a specified period (usually 1-3 months).

4. The formulation was observed at regular intervals for:

- Colour change
- Odour change
- pH variation
- Viscosity change
- Phase separation
- Precipitation

Washability Test :-

The washability test determines how easily a herbal analgesic liniment can be removed from the skin surface using water.

Procedure

1. A small amount of the liniment was applied to the skin (or a glass plate).

2. The liniment was allowed to remain for a fixed time (5-10 minutes). The applied area was then washed with normal water.

3. The area was gently rubbed, and the ease of removal was observed.

4. It was noted whether any oily film, stickiness, or residue remained.

Permeation Flux :-

The permeation flux method is an in vitro technique used to determine the rate at which a soluble active constituent (analyte) passes through a biological or synthetic membrane per unit area over a specified period of time. It is commonly employed to evaluate the permeation characteristics of topical and transdermal formulations such as liniments, gels, creams, and patches. The permeation flux is expressed as:

$$J = dQ/A\,dt$$

Where:

J = Permeation flux (µg/cm²/h)

dQ/dt = Rate of permeation of the analyte

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A = Effective membrane area

Procedure :-

1) The dialysis membrane was soaked in phosphate buffer (pH 7.4) overnight to ensure complete hydration.

2) The hydrated membrane was mounted carefully between the donor and receptor compartments of the Franz diffusion cell, with the epidermal side facing the donor compartment.

3) The receptor compartment was filled with phosphate buffer (pH 7.4) and maintained at 37 ± 0.5°C using a thermostatically controlled water bath.

4) Continuous stirring was provided using a magnetic stirrer at 50–100 rpm to maintain uniform distribution of the permeated drug.

5) An accurately measured quantity (1 mL) of polyherbal analgesic liniment was placed in the donor compartment over the membrane surface.

6) At predetermined time intervals (0.5, 1, 2, 4, 6, and 8 hours), 1 mL samples were withdrawn from the receptor compartment.

7) After each withdrawal, an equal volume of fresh phosphate buffer maintained at the same temperature was added to maintain sink conditions.

8) The collected samples were analyzed using a UV-Visible spectrophotometer at the appropriate wavelength for the selected marker compound.

9) The cumulative amount of drug permeated per unit area was calculated and plotted against time.

10) The permeation flux was determined from the slope of the linear portion of the cumulative permeation versus time plot.

RESULTS AND DISCUSSION

Table No.3 Formulation Result

S.No.	Parameters	F1	F2	F3
1	Colour	Pale yellow	Yellowish green	Dark yellowish green
2	Odour	Pleasant aromatic	Strong aromatic	Very strong aromatic
3	pH	5.8 ± 0.1	6.1 ± 0.1	6.3 ± 0.1
4	Viscosity	120 ± 5	145±4	170 ± 6
5	Washability	Good	Excellent	Good
6	Phase separation	Absent	Absent	Absent
7	Over all acceptability	Good	Excellent	Very good

Based on the evaluation results, Batch F2 was selected as the optimized formulation.

Discussion after formulation

Based on the evaluation results, Batch F2 was selected as the optimized formulation.

because it exhibited:

- Excellent homogeneity
- Optimum viscosity

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- Better spreadability
- Good physical stability
- No phase separation
- Acceptable sensory characteristics
- No skin irritation

Among all three formulations, F2 demonstrated the most desirable physicochemical properties and stability characteristics. The balanced concentration of herbal oils, counter-irritants, and beeswax provided optimum consistency, ease of application, and expected analgesic activity. Therefore, F2 was selected as the optimized polyherbal analgesic liniment formulation for further studies and potential use in the management of arthritis and musculoskeletal pain.

OPTIMIZATION STUDY FOR F2 FORMULATION

Stability study

Table No.4 Stability study

Formulation	Storage condition	% Drug remain		
		Initial	1 Month	3 Month
F2	30°C ± 2°C / 65% RH ± 5% RH	99.62	99.54	99.05
	40°C ± 2°C / 75% RH ± 5% RH	99.62	99.53	99.06

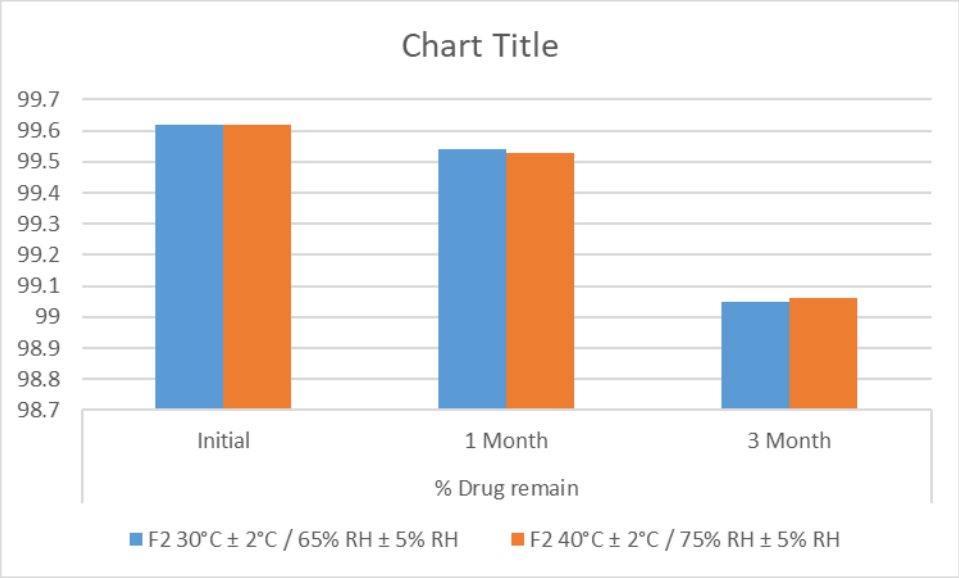

Fig. No 01 – Stability study Graph

According to graph we observed that that F2 formulation is Stable in different storage conditions So, F2 formulation was selected as the optimized polyherbal analgesic liniment formulation for further studies and potential use in the management of arthritis and musculskeletal pain.

Permeation flux study for F2 formulation

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Table no. 5 Permeation flux study

Time (h)	Cumulative Amount Permeated (mg/cm2)	Cumulative Drug Permeation (%)	Permeation Flux (mg/cm²/h)
0	0.00	0.00	0.000
1	0.72 ± 0.03	12.45 ± 0.42	0.720
2	1.48 ± 0.05	25.62 ± 0.65	0.740
3	2.25 ± 0.06	38.94 ± 0.78	0.750
4	3.01 ± 0.08	52.08 ± 0.92	0.753
5	3.78 ± 0.09	65.40 ± 1.05	0.756
6	4.55 ± 0.11	78.72 ± 1.14	0.758

According to Permeation flux study F2 formulation showed the highest permeation flux, indicating better release and permeation of the active constituents. The enhanced permeation may be attributed to the optimum concentration of herbal oils and penetration enhancers present in the formulation**.**

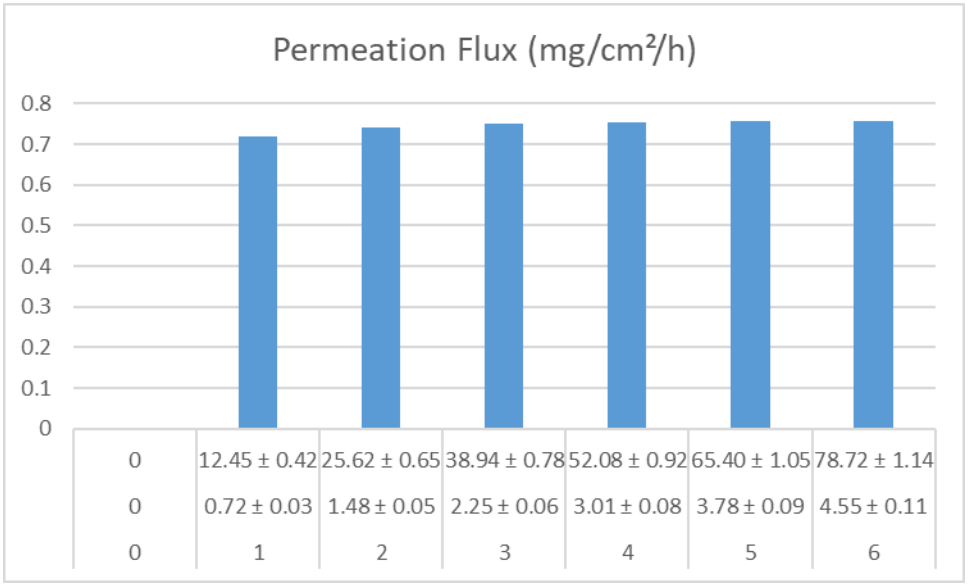

Fig. No 02 – Permeation flux Graph .

According to graph F2 formulation showed the highest permeation flux.

CONCLUSION

The present study concluded that the formulated polyherbal analgesic liniment is a safe, stable, and effective herbal topical preparation for the treatment and management of arthritis. The formulation showed satisfactory physicochemical properties such as good homogeneity, suitable viscosity, excellent spreadability, easy washability, and absence of phase separation. The pH of the formulation was found to be compatible with skin, and the patch test revealed no signs of irritation or allergic reaction, indicating its safety for topical application. The herbal ingredients including Coconut Oil, Clove Oil, Eucalyptus Oil, nirgundi oil, menthol, and camphor may provide significant analgesic and anti-inflammatory effects, which help in reducing joint pain, inflammation, stiffness, and muscular discomfort associated with arthritis. The accelerated stability study confirmed that the formulation remained physically stable under different storage conditions without significant changes in appearance, odor, pH, or consistency. Therefore, the developed polyherbal analgesic liniment can be considered a promising herbal alternative for topical arthritis therapy with good patient compliance and minimal side effects.

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REFERENCES

[1] Warke, S. P., Joshi, P., Patil, R., & Patil, K. (2026). Formulation and evaluation of herbal pain relief cream. International Journal of Creative and Open Research in Engineering and Management, 2(5), 1–7. https://doi.org/10.55041/IJCOPE.V2I5.763.
[2] Wulansari, E., Widyaningrum, N., Anggraeni, R. S., Wardah, O. S., & Ulya, I. B. (2026). Liniment formulation with a combination of red palm oil and virgin coconut oil base ingredients. Asian Journal of Healthy and Science, 5(2), 60–70. https://doi.org/10.58631/AJHS.V5I2.271.
[3] Sisignano M, et al. Mechanisms of action of topical analgesics in pain management. Pain Research Journal. 2025.
[4] Krishna KR, et al. Development and evaluation of herbal topical analgesic formulations. International Journal of Pharmaceutical Research. 2025.
[5] Sabry HS, et al. Herbal topical formulations for localized therapeutic effects: formulation and evaluation. Journal of Drug Delivery Science and Technology. 2025.
[6] Bindod HV, Dafe VN, Hatwar PR, Bakal RL. Formulation and evaluation of herbal analgesic balm. Journal of Drug Delivery and Therapeutics. 2025;15(8):27–33. doi:10.22270/jddt.v15i8.7296
[7] More SV, Wankhede K. Development and efficacy testing of a herbal analgesic balm. International Journal of Novel Research and Development. 2025;10(4):e26–e35. Available from: https://ijnrd.org/papers/IJNRD2504404.pdf
[8] Pena OA, Martin P. Cellular and molecular mechanisms of skin wound healing. Nat Rev Mol Cell Biol. 2024;25(8):599-616 https://doi.org/10.1038/s41580-024-00715-1 PMid:38528155
[9] Sahu K. Development and characterization of analgesic herbal balm using herbs as a medicine. GSC Advanced Research and Reviews. 2024:19(03);122-127. https://doi.org/10.30574/gscarr.2024.19.3.0200
[10] Heinrich M, et al. Botanical topical formulations and their therapeutic potential. Journal of Ethnopharmacology. 2024.
[11] Lawrance S. Evaluation of contact sensitivity to sodium benzoate in topical formulations. International Journal of Dermatology Research. 2024;10(3):112–118.
[12] Das S. Formulation and evaluation of coconut oil-based nanoemulsion for enhanced topical analgesic activity. Journal of Pharmaceutical Research and Development. 2024;12(2):78–85
[13] Angeles-Agdeppa I. Clinical evaluation of virgin coconut oil for the management of dialysisrelated leg pain. Philippine Journal of Science. 2024;153(2):245–252.