

DEVELOPMENT AND EVALUATION OF GINGER-BASED HERBAL LINIMENT FOR MUSCLE AND JOINT INFLAMMATION

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ABSTRACT

Inflammation and pain associated with muscles and bones are common health problems that affect daily activities and quality of life. Conventional anti-inflammatory drugs such as NSAIDs provide effective relief but are often associated with adverse effects like gastric irritation, kidney damage, and cardiovascular complications during long-term use. Therefore, the development of safe and effective herbal alternatives has gained significant attention in pharmaceutical research. The present study focuses on the formulation and evaluation of a herbal ginger liniment for anti-inflammatory activity on muscles and bones. Ginger (*Zingiber officinale*) is well known for its anti-inflammatory, analgesic, antioxidant, and rubefacient properties due to the presence of active constituents such as gingerols and shogaols. In this study, ginger extract was incorporated into a liniment formulation along with ingredients such as camphor, methyl salicylate, menthol, and turpentine oil to enhance therapeutic activity. The liniment was prepared using suitable pharmaceutical methods and evaluated for various parameters including physical appearance, homogeneity, pH, viscosity, stability, skin irritation, and anti-inflammatory activity. The prepared formulations showed good physical characteristics, acceptable pH, satisfactory stability, and no skin irritation. The anti-inflammatory activity confirmed the effectiveness of the ginger-based formulation in providing topical relief from pain and inflammation. The warming and counter-irritant effects of the formulation also contributed to improved blood circulation and muscle relaxation. The study concludes that ginger liniment is a promising herbal topical preparation for the management of muscle and joint inflammation. It offers a safer, cost-effective, and natural alternative to conventional synthetic formulations with minimal side effects and good patient acceptability.

KEYWORDS: Ginger liniment, herbal formulation, anti-inflammatory activity, *Zingiber officinale*, topical drug delivery, muscle pain relief, joint inflammation.

INTRODUCTION

Inflammation is a natural protective response of the body against injury, infection, or harmful stimuli. It commonly affects muscles and bones, leading to pain, swelling, redness, stiffness, and reduced mobility. Musculoskeletal inflammatory conditions such as arthritis, joint pain, muscular pain, rheumatism, sports injuries, and backache

are increasingly common due to ageing, lifestyle changes, stress, and physical strain. Conventional anti-inflammatory drugs such as non-steroidal anti-inflammatory drugs (NSAIDs) and corticosteroids are widely used for the treatment of these conditions. Although these drugs provide effective relief, prolonged use may produce adverse effects including gastric

irritation, ulcers, kidney damage, liver toxicity, and cardiovascular complications.

Herbal medicines have gained significant importance in recent years because of their natural origin, safety, effectiveness, and fewer side effects. Among various medicinal plants, ginger (*Zingiber officinale*) is one of the most widely used herbs in traditional and modern medicine. Ginger contains important bioactive constituents such as gingerols, shogaols, paradols, and zingerone, which possess anti-inflammatory, analgesic, antioxidant, and rubefacient properties. These active compounds inhibit inflammatory mediators like prostaglandins and leukotrienes by suppressing cyclooxygenase (COX) and lipoxygenase (LOX) pathways. Ginger also reduces oxidative stress and cytokine production, thereby helping in the management of inflammation and pain.

Topical dosage forms such as liniments are commonly used for localized treatment of pain and inflammation. Liniments are liquid or semi-liquid pharmaceutical preparations applied externally with rubbing or massage. They provide rapid relief by increasing blood circulation and delivering active ingredients directly to the affected area. Compared to oral medications, topical liniments reduce systemic side effects and improve patient compliance. Herbal liniments containing natural ingredients are becoming popular because they are safer and suitable for long-term use. The present study focuses on the formulation and evaluation of a herbal ginger liniment for anti-inflammatory activity on muscles and bones. The formulation contains ginger extract along with camphor, methyl salicylate, menthol, and turpentine oil, which together enhance analgesic, counter-irritant, and anti-inflammatory effects. The prepared liniment was evaluated for various parameters such as physical appearance, pH, viscosity, stability, skin irritation, and anti-inflammatory activity. The study aims to develop a safe, effective, economical, and natural topical preparation for the management of muscle and joint inflammation.

MATERIAL AND METHODOLOGY

Selection of Active Ingredients
Collection of Active Ingredients
Method of Extraction of Ginger Extract
Composition of herbal ginger liniment
Evaluation of Ginger liniment

RESULT

Active Ingredients Used In Formulation

GINGER

Biological Source: Dried rhizomes of *Zingiber officinale* (Family: Zingiberaceae)

Chemical Constituents:

Gingerols (main active compounds)

Shogaols (formed on drying)

Zingerone

Volatile oils (zingiberene, bisabolene)

Category : Herbal anti-inflammatory , Carminative

Uses : Carminative

Relief from Joint pain

Mechanism of Action

Inhibit inflammatory mediator like prostaglandins by blocking COX enzyme.



Fig. No. 01: Ginger.

Other Ingredients Used In Formulation

CAMPHOR

Biological Source: Obtained from wood of *Cinnamomum camphora* or synthesized.

Category

Counterirritant

Rubefacient

Mild analgesic

Chemical Constituents:

Terpenoid ketone (camphor)

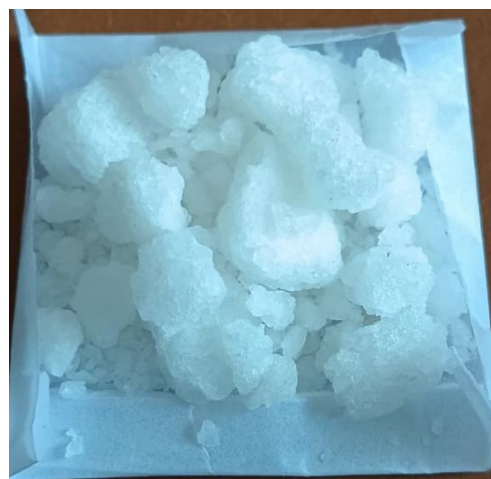


Fig. No. 02: Camphor.

Mechanism of Action

Stimulates sensory nerve endings, producing a warming or cooling sensation and increasing blood flow.

Uses

Relief of muscular pain

Anti-inflammatory preparations

Used in liniments, balms, oils

2. METHYL SALICYLATE

Synonyms: Wintergreen oil

Category

Counterirritant

Chemical Nature: Methyl ester of salicylic acid



Fig. No. 03: Methyl Salicylate.

Mechanism of Action

Produces irritation and warmth on the skin, which distracts from deeper pain (counterirritant effect). Also inhibits prostaglandin synthesis.

Uses

Muscle and joint pain relief
Arthritis and rheumatis

3. TURPENTINE OIL

Biological Source

Obtained by distillation of resin from *Pinus* species (Family: Pinaceae).

Category: Rubefacient, Counterirritant

Chemical Constituents: Alpha-pinene, Beta-pinene,

Limonene

Mechanism of Action: Irritates the skin, causing vasodilation and increased blood flow, which helps relieve pain.

Uses: Muscle and joint pain

Used in liniments and massage oils



Fig. No. 04: Turpentine oil.

Ingredients Collection & Category Table

Table No. 01: Ingredients Collection & Category Table.

Sr.No	Ingredients	Collection	Category
1.	Ginger Extract (Oil)	L.s.d.p college of pharmacy Mandavgan pharata	Anti-inflammatory Agent
2.	Camphor	L.s.d.p college of pharmacy Mandavgan pharata	Analgesic & Cooling Agent
3.	Methyl salicylate	L.s.d.p college of pharmacy Mandavgan pharata	Counterirritant
4.	Menthol	L.s.d.p college of pharmacy Mandavgan pharata	Cooling Agent
5.	Turpentine Oil	L.s.d.p college of pharmacy Mandavgan pharata	Rubefacient agent
6.	Ethanol (95%)	L.s.d.p college of pharmacy Mandavgan pharata	Solvent
7.	Purified water	L.s.d.p college of pharmacy Mandavgan pharata	q.s solvent
8.	Sudan red 3	L.s.d.p college of pharmacy Mandavgan pharata	Colouring Agent

Extraction of Ginger Oil

1. Preparation of Ginger

First, take fresh ginger rhizomes and wash them properly to remove dirt. Then cut or crush them into small pieces. Crushing helps in releasing more oil during extraction.

2. Loading the Apparatus

Transfer the crushed ginger into a round bottom flask and add sufficient distilled water to completely immerse the material.

3. Assembly of Clevenger Apparatus

Connect the flask to the Clevenger apparatus and attach a condenser. Make sure all joints are tight to avoid vapor leakage.

3. Heating Process

Start heating the mixture using a heating mantle. As the temperature rises, water starts boiling and produces steam carrying the volatile ginger oil.

3. Condensation

The vapor passes through the condenser, where it cools down and converts into liquid (a mixture of water and oil).

4. Separation of Oil

The condensed liquid collects in the graduated tube of the Clevenger apparatus. Since ginger oil is lighter than water, it floats on the surface and separates naturally.

5. Collection of Oil-complete, usually after 6-7 hours of continuous distillation.



Fig. No. 05: Assembly of Ginger Extraction using Cleveanger apparatus.

The oil layer is carefully collected after the process is Formulation Table (For 50 ml).

Table No.02 Formulation Table.

Sr.no.	Ingriendts	F1	F2	F3
1.	Ginger Extract	2.5 ml	2.4ml	2.5
2.	Methyl salicylate	5 ml	5 ml	5 ml
3.	Menthol	1 ml	1 ml	1 ml
4.	Camphor	2.5gm	2.5gm	2.5gm
5.	Turpentine oil	5ml	5ml	5ml
6.	Ethanol	30 ml	30 ml	30 ml
7.	Purified water	q .s 50ml	q .s 50ml	q .s 50ml
8.	Colouring Agent (Sudan red 3)	2 drops	2 drops	drops

Preparation of Liniment

1. Preperation of Ginger oil–
Extract a ginger oil using Cleveanger apparatus

2. Preperation of Liniment

Dissolve Camphor and menthol in ethanol
Add methyl salicylate and turpentine oil
Incorporate Ginger Extract With Continuous stirring

Make up the value with purified Water
Mix Thoroughly with homogeneous mixture

3. Packaging

Store in transparent bottle
Lable with appropriate instructions

4. Storage- Store in dry and cool place



Fig. No. 06: Procedure carry in the laboratory experiment.



Fig. No. 07: Final Product Ginger Liniment.

Evaluation of Ginger Liniment

Evaluation tests for Ginger Extract Liniment are carried out to check the quality, stability, and effectiveness of the

prepared formulation. The common evaluation parameters are:

1. Physical Appearance

The prepared liniment is observed visually for color, odor, clarity, and homogeneity. A good liniment should have a uniform appearance without phase separation or precipitation.

2. pH Determination

The pH of the liniment is measured using a digital pH meter. The pH should be suitable for skin application (generally around 4.5–7) to avoid irritation.

3. Viscosity

Viscosity indicates the flow property of the liniment. It can be measured using a viscometer (Brookfield viscometer) to ensure the formulation spreads easily on the skin.

4. Stability Study

The formulation is stored at different conditions (room temperature, refrigerated, and elevated temperature) and observed for changes in color, odor, pH, or phase separation over time.

5. Skin Irritation Test

A small quantity of liniment is applied to a small area of skin (patch test) to observe any redness, itching, or irritation.

6. Anti-inflammatory Activity

The prepared liniment can be evaluated for its anti-inflammatory effect using suitable experimental models to confirm the therapeutic activity of ginger extract.

RESULT

Table No. 03: Result of Ginger Liniments.

Sr.no.	Parameter	F1	F2	F3
Organoleptic character				
1.	Colour	Pale yellow	Pale yellow	Pale yellow
2.	Odour	Warm and Spicy	Fresh note	Fresh Note
3.	Homogeneity	Biaphasic(Oil + water phase)	Biaphasic (Oil + Water Phase)	Biaphasic (Oil + Water Phase)
4.	Viscosity	0.57 poise	0.56poise	0.52 poise
5.	pH Determination	6	7	6
6.	Stability Study	Stable at room temperature	Stable at room temperature	Stable at room temperature
7.	Skin irritation test	No	No	No
8.	Anti-inflammatory Activity	Yes	Yes	Yes

CONCLUSION

The present study successfully demonstrated the formulation and evaluation of a herbal ginger liniment for anti-inflammatory activity on muscles and bones.

Ginger (*Zingiber officinale*), known for its potent anti-inflammatory and analgesic properties, was effectively incorporated into the liniment formulation along with camphor, menthol, methyl salicylate, and turpentine oil

to enhance therapeutic effectiveness. The prepared formulations showed satisfactory physical appearance, acceptable pH, suitable viscosity, good stability, and no signs of skin irritation.

The anti-inflammatory evaluation confirmed that the ginger liniment possesses effective topical activity in reducing pain, swelling, and muscular discomfort. The formulation also provided warming and counter-irritant effects, which help improve blood circulation and relieve stiffness in affected areas. Compared to conventional synthetic anti-inflammatory preparations, the herbal formulation offers advantages such as reduced side effects, better patient compliance, cost-effectiveness, and natural therapeutic benefits.

Therefore, ginger liniment can be considered a promising herbal topical preparation for the management of muscle and joint inflammation. The study also highlights the growing importance of herbal medicines in modern pharmaceutical formulations and supports the use of natural products as safer alternatives for long-term therapy.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this project work.

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