



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Review Article

A Review on Formulation and Evaluation of a Topical Herbal Approach for Menstrual Pain Relief

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ARTICLE INFO

Published: 23 Feb 2026

Keywords:

Dysmenorrhea, Polyherbal formulation, Topical therapy, Essential oils, Menstrual pain.

DOI:

10.5281/zenodo.18749439

ABSTRACT

Dysmenorrhea is a prevalent gynecological disorder affecting women of reproductive age and significantly impairing quality of life. Conventional management primarily involves non-steroidal anti-inflammatory drugs and hormonal contraceptives; however, prolonged use of these therapies may be associated with adverse effects. Increasing interest has been directed toward safer complementary approaches, particularly topical polyherbal formulations. This review critically analyzes published literature on herbal topical systems used for menstrual pain relief, with emphasis on essential oils demonstrating analgesic, anti-inflammatory, and antispasmodic properties. Essential oils such as peppermint, lavender, fennel, chamomile, ginger, and *Nigella sativa* have been reported to modulate prostaglandin synthesis, inflammatory mediators, and smooth muscle contraction. Topical delivery systems including roll-ons and oil-based preparations offer localized action, reduced systemic exposure, improved patient compliance, and ease of application. Available evidence suggests that topical polyherbal formulations represent promising non-invasive alternatives for dysmenorrhea management. However, further standardized clinical studies are required to establish long-term safety and consistent therapeutic efficacy.

INTRODUCTION

Dysmenorrhea, commonly known as menstrual cramps, is a common gynecological condition affecting women of reproductive age. It is characterized by throbbing or cramping pain in the lower abdomen that may occur before or during menstruation. [1] The global prevalence of

dysmenorrhea ranges from 45% to 95%, significantly affecting quality of life and daily activities. [6]

In addition to abdominal pain, dysmenorrhea is often associated with systemic symptoms such as nausea, vomiting, headache, fatigue, back pain, and diarrhea. The condition is primarily caused by

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



increased production of prostaglandins, particularly Prostaglandin $F_{2\alpha}$ and Prostaglandin E_2 , which result in strong uterine contractions, reduced uterine blood flow, and ischemic pain. [2,3]

Dysmenorrhea is classified into primary and secondary types. Primary dysmenorrhea occurs without underlying pelvic pathology, whereas secondary dysmenorrhea is associated with conditions such as endometriosis or pelvic inflammatory disease. [2]

Conventional treatment mainly includes non-steroidal anti-inflammatory drugs (NSAIDs) and oral contraceptive pills. NSAIDs such as ibuprofen and mefenamic acid reduce pain by inhibiting prostaglandin synthesis. [2] However, prolonged NSAID use is associated with gastrointestinal irritation, cardiovascular risks, and other adverse drug reactions. [9] These limitations have encouraged exploration of safer alternative therapies. [6]

Herbal medicine has gained attention in pain management due to its anti-inflammatory and analgesic properties. Essential oils such as chamomile, [1] lavender, [16] thyme, [18] fennel, [20] ginger, [21] and *Nigella sativa* [3] have demonstrated beneficial effects in reducing menstrual pain through modulation of inflammatory pathways and smooth muscle relaxation.

Recently, topical herbal formulations such as roll-ons and oil-based preparations have emerged as promising alternatives for dysmenorrhea management. [4,8,10] These systems provide localized delivery of active constituents, minimize systemic exposure, and improve patient compliance. Topical application over the lower abdominal region allows direct action at the site of pain with reduced systemic side effects. [3]

Due to their safety, ease of application, and non-invasive nature, topical polyherbal formulations represent a promising complementary approach for the management of menstrual pain.

Several researchers have studied dysmenorrhea and alternative management approaches:

- **Itani et al. (2022)** reported that dysmenorrhea is mainly caused by increased prostaglandin production leading to uterine contractions. They highlighted the need for safer alternatives due to adverse effects of conventional therapy.
- **Moore et al. (2015)** discussed adverse drug reactions of NSAIDs, including gastrointestinal bleeding and cardiovascular risks, and emphasized the importance of safer pain management options.
- **Patil et al. (2024)** developed a herbal menstrual pain relief balm containing essential oils such as clary sage, eucalyptus, peppermint, lavender, and frankincense. The formulation showed effective pain relief with good skin compatibility.
- **Padmaja et al. (2022)** formulated a herbal pain relief roll-on containing eucalyptus, camphor, thyme, lavender, rosemary, chamomile, and peppermint. The roll-on showed rapid onset of action and significant analgesic effects.
- **Bagal et al. (2025)** reviewed herbal roll-on formulations and reported their benefits such as localized action, quick relief, minimal side effects, and improved patient compliance.
- **Han et al. (2017)** demonstrated anti-inflammatory activity of cinnamon bark oil, supporting its use in topical pain formulations.



- **Jyothsna et al. (2017)** reported that herbal transdermal systems improve drug permeation and reduce systemic side effects.

AIM & OBJECTIVE

Aim:

To critically review and analyze topical herbal approaches for menstrual pain relief, with emphasis on selected essential oils possessing analgesic, anti-inflammatory, and antispasmodic properties.

Objectives:

1. To review the pathophysiology of dysmenorrhea and limitations of conventional therapies.
2. To analyze herbal ingredients and essential oils used in topical formulations for menstrual pain relief.
3. To summarize formulation approaches for topical herbal preparations.
4. To review evaluation parameters applied to topical herbal formulations.
5. To compare effectiveness, onset of action, and user acceptability of topical herbal systems.

METHODOLOGY OF LITERATURE REVIEW

Literature Selection and Data Collection

The present work was conducted as a literature-based review. Data related to herbal topical formulations used for the management of dysmenorrhea were collected from published research articles, review papers, and clinical studies available in scientific databases. Relevant literature focusing on essential oils, carrier oils, formulation requirements, mechanisms of action, and reported efficacy of topical herbal systems was systematically analyzed. Only peer-reviewed sources were considered to ensure reliability and scientific validity.

Requirements for Herbal Topical Systems

Review studies reported that the preparation of herbal topical formulations for period pain relief requires specific materials, including essential oils, carrier oils, stabilizers, antioxidants, processing aids, and suitable packaging components. The literature emphasized that proper standardization of essential oils, use of appropriate carrier oils, and inclusion of stabilizers and antioxidants are critical for achieving stable and consistent topical systems. Additionally, adequate processing equipment, quality control measures, and suitable storage conditions were identified as essential to ensure safety, stability, and effectiveness of topical herbal preparations. The major herbal ingredients and essential oils reported in the literature for dysmenorrhea management are summarized in Table 1.

Table 1. Major Essential Oils Used in Topical Herbal Systems for Period Pain Relief

Sr. No.	Herbal Ingredient / Essential Oil	Major Active Constituents	Pharmacological Action	Mechanism of Action
1	Peppermint oil	Menthol, menthone	Analgesic, antispasmodic	TRPM8 activation, Na ⁺ blockade
2	Lavender oil	Linalool, linalyl acetate	Analgesic, CNS relaxant	GABA modulation
3	Fennel oil	Anethole	Antispasmodic, anti-inflammatory	Ca ²⁺ inhibition



4	Thyme oil	Thymol, carvacrol	Anti-inflammatory	COX-2 inhibition, NF- κ B suppression
5	Mugwort oil	Cineole, thujone	CNS modulator, antispasmodic	GABA-A modulation
6	Chamomile oil	α -Bisabolol, chamazulene	Sedative, anti-inflammatory	COX inhibition, GABA-A activation
7	Ginger oil	Gingerol, shogaol	Anti-inflammatory	Prostaglandin & leukotriene inhibition
8	Nigella sativa oil	Thymoquinone	Analgesic, antioxidant	COX, LOX, NF- κ B suppression
9	Turmeric oil	Curcumin, ar-turmerone	Anti-inflammatory	NF- κ B and COX-2 inhibition
10	Artemisia vulgaris oil	Cineole, camphor	Antispasmodic	Ca ²⁺ modulation, GABAergic action
11	Cinnamon oil	Cinnamaldehyde	Analgesic, antimicrobial	TRPA1 modulation
12	Marjoram oil	Terpinen-4-ol	Sedative & antispasmodic	GABAergic modulation, Ca ²⁺ inhibition
13	Coconut oil	Lauric acid	Penetration enhancer, anti-inflammatory	Antioxidant modulation
14	Almond oil	Oleic acid, Vitamin E	Emollient, anti-inflammatory	Membrane stabilization

REPORTED METHODOLOGY FOR PREPARATION OF HERBAL PERIOD PAIN RELIEF TOPICAL SYSTEMS

Published studies have described generalized methodologies for the development of herbal topical pain-relief systems. These reported methods include sequential steps such as selection and standardization of herbal actives, blending with suitable carrier oils, incorporation of stabilizers, quality evaluation, and appropriate packaging. [4,8,10]

• Selection and Standardization of Herbal Actives and Essential Oils

The literature reported that essential oils with proven effectiveness in dysmenorrhea management were selected based on pharmacological activity. [1,2,3] Commonly used oils such as lavender, thyme, fennel, chamomile, and Nigella sativa have demonstrated anti-inflammatory and analgesic properties. [16,18,20,25]

These oils were obtained using techniques such as steam distillation, solvent extraction, or cold pressing. [16, 17] Standardization was achieved to ensure batch-to-batch consistency using analytical techniques such as GC-MS or HPLC for identification and quantification of active constituents. [17, 21]

• Blending with Carrier Oils in Defined Ratios

According to formulation studies, standardized essential oils were blended with suitable carrier oils to obtain a stable and therapeutically effective topical base. [4,8,10] Carrier oils such as virgin coconut oil and almond oil were commonly reported due to their good dermal compatibility and penetration-enhancing properties. [25,26]

Homogeneous mixing for 10–15 minutes was described to ensure uniform distribution of active constituents within the formulation. [4,8]

• Addition of Stabilizers and Antioxidants



Literature sources indicated that antioxidants such as butylated hydroxytoluene (BHT) were incorporated to prevent oxidative degradation of volatile essential oils and to enhance formulation stability. [4,5] Additives such as propylene glycol were reported to improve uniformity, spreadability, and overall stability of the topical preparation. [4,5]

- **Filtration, Filling, and Packaging**

Reported methodologies emphasized the importance of hygienic processing conditions during formulation development. [4,8] Filtration was performed to remove particulate matter and ensure clarity of the formulation. Microbial testing and quality evaluation were conducted to confirm product safety and stability. [4,10]

Suitable roll-on containers or topical applicators with proper sealing and labeling were recommended to maintain product integrity. Storage under cool and dry conditions was suggested to preserve stability and therapeutic effectiveness. [4,8]

RESULTS OF LITERATURE REVIEW

Analysis of published literature indicates that topical herbal therapeutic systems are widely reported for the management of primary dysmenorrhea. Previous studies describe a relatively rapid onset of pain relief, effective localized delivery of herbal active constituents, and reduced systemic exposure when compared to oral analgesics.

Essential oils including peppermint, fennel, ginger, cinnamon, and lavender are frequently reported to exhibit analgesic, antispasmodic, and anti-inflammatory activities in topical applications. The reviewed studies also report good tolerability, minimal adverse effects, and

favorable user acceptance, particularly among individuals who are intolerant to non-steroidal anti-inflammatory drugs (NSAIDs).

Collectively, the reviewed findings provide supporting evidence for the potential utility of topical herbal systems in menstrual pain management, as documented across multiple published studies.

DISCUSSION

The reviewed studies show that topical herbal therapeutic systems are useful in the management of dysmenorrhea. Many reports indicate that pain relief occurs quickly after application because the herbal ingredients act directly at the site of pain. This supports earlier findings that volatile herbal components are easily absorbed through the skin and produce fast analgesic effects.

Transdermal delivery of herbal actives allows gradual penetration into skin layers, which helps in maintaining longer pain relief. Compared to oral medicines, topical application reduces systemic exposure and avoids first-pass metabolism, thereby improving safety. These observations are in agreement with previous studies highlighting the advantages of topical herbal formulations.

Most studies describe topical herbal products as safe and well tolerated, with very few adverse effects. This makes them suitable for individuals who cannot tolerate non-steroidal anti-inflammatory drugs due to gastrointestinal or other systemic side effects. The ability to remove the product easily in case of discomfort provides additional safety.

Ease of use and convenience play an important role in user acceptance. Portable packaging, simple application, and targeted use at the painful area improve compliance. The mild massaging



action during application may also contribute to pain relief.

CONCLUSION

Available literature indicates that topical herbal therapeutic systems offer a promising complementary approach for the management of primary dysmenorrhea. Essential oils such as peppermint, lavender, fennel, cinnamon, and ginger demonstrate analgesic, antispasmodic, and anti-inflammatory activities through multiple pharmacological mechanisms. Topical delivery provides localized, non-invasive pain relief with reduced systemic exposure, improved safety, and better patient compliance compared to conventional oral therapies.

Although current findings are encouraging, further standardized formulations, well-designed clinical trials, and long-term safety evaluations are required to establish consistent efficacy and broader clinical acceptance of topical herbal treatments for menstrual pain relief.

ACKNOWLEDGEMENT

The authors express sincere gratitude to the Principal and faculty members of the Department of Pharmacy for their valuable guidance, encouragement, and continuous support in the preparation of this review article.

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HOW TO CITE: Ujjwala Doltade, Harshada Mahadik, Shivani Menbudle, Soham Marathe, Amar Lokhande, Adhiraj Mhatre, A Review on Formulation and Evaluation of a Topical Herbal Approach for Menstrual Pain Relief, *Int. J. of Pharm. Sci.*, 2026, Vol 4, Issue 2, 3792-3798. <https://doi.org/10.5281/zenodo.18749439>