

Formulation and Evaluation of Herbal Anti-Inflammatory Oil Using *Tamarindus indica* Oil, *Vitex negundo* Oil and *Ipomoea batatas* Oil

Amol Tanaji Ubale¹, Sawant Sakshi Satish^{2*}, Sutar Rishikesh Vishnu³, Nadaf Juber Shahajahan⁴, Pandhare Suhas Vilas⁵, Shinde Shravani Mahadev⁶

Abstract

The formulation and evaluation of an herbal anti-inflammatory oil derived from the leaves of *Tamarindus indica* (Tamarind) *Ipomoea batatas* (Sweet potato) *Vitex negundo* (Nirgundi) aim to explore the therapeutic potential of these plants in managing pain and inflammation. Tamarind leaves are rich in flavonoids, like quercetin, which primarily provide anti-inflammatory benefits by inhibiting pro-inflammatory cytokines, though their analgesic effects are moderate. Nirgundi leaves contain eugenol, known for its strong analgesic properties, offering immediate pain relief and effective modulation of inflammatory pathways. Sweet potato leaves, packed with vitamins and antioxidants, complement these oils by promoting healing and further reducing inflammation. When combined, the strengths of all these three plants create a synergistic effect, enhancing overall efficacy.

Keywords: Herbal analgesic and anti-inflammatory oil, *Tamarindus indica*, *Vitex negundo*, *Ipomoea batatas*

INTRODUCTION

The formulation and evaluation of herbal anti-inflammatory oils utilizing *Tamarindus indica* and *Vitex negundo* and *Ipomoea batatas* leaves represent a significant advancement in traditional medicine, offering a natural alternative for pain management and inflammation reduction. *Tamarindus indica*, commonly known as tamarind, is recognized for its diverse pharmacological effects, including anti-inflammatory and analgesic activities. Studies have shown that extracts from its leaves can inhibit pro-inflammatory mediators and exhibit significant pain-relieving effects [1–4]. Similarly, *Vitex negundo*,

known as the Chinese chaste tree, has been traditionally used to treat various ailments, including pain and inflammation. *Tamarindus indica*, commonly used in traditional medicine, exhibits strong anti-inflammatory and analgesic properties. Various parts of the plant – such as the pulp, leaves, seeds, stem bark, and roots – contain bioactive compounds, like alkaloids and flavonoids, that contribute to these effects [5].

Sweet potato (*Ipomoea batatas*) leaves have been traditionally used for their anti-inflammatory and pain-relieving properties, which may benefit joint health. These leaves are rich in flavonoids and phenolic compounds, both of which have antioxidant and anti-inflammatory effects, helping to reduce inflammation and oxidative stress in the body [6, 7].

*Author for Correspondence

Sawant Sakshi Satish
E-mail: sakshisawant578@gmail.com

¹Vice Principal, Department of Pharmacy, Vijayrao Naik College of Pharmacy, Shirval, Kankavli, Sindhudurg, Maharashtra, India

²⁻⁶Students, Department of Pharmacy, Vijayrao Naik College of Pharmacy, Shirval, Kankavli, Sindhudurg, Maharashtra, India

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These properties can be especially beneficial for conditions, like arthritis, as they may help alleviate swelling and pain in the joints. Additionally, sweet potato leaves contain essential vitamins, such as A, C, and E, which further support anti-inflammatory responses and contribute to collagen formation, crucial for joint health.

Uses of Anti-Inflammatory Oil

- *Pain Relief*: For sore muscles, joint pain, and headaches.
- *Skin Irritation*: Reducing swelling and redness from conditions like eczema, acne, and psoriasis.
- *Respiratory Issues*: Easing inflammation in the airways, helpful for colds or asthma.
- *Arthritis Relief*: Reducing inflammation in the joints to relieve discomfort from conditions like rheumatoid arthritis and osteoarthritis.
- *Wound Healing*: Promoting faster healing of cuts, bruises, and minor burns by reducing inflammation.

Topical Drug Delivery System

When a topical drug is applied to the skin, it first encounters the stratum corneum, the outermost layer. There are three primary pathways for the drug to penetrate deeper into the skin. The first is the appendageal route, where the drug can enter through skin appendages, such as sweat glands, effectively bypassing the stratum corneum barrier. If the drug does not utilize this route, it may travel through the paracellular route, which involves moving between skin cells at their junctions. This pathway requires the drug to navigate through the lipid-rich environment of the stratum corneum. Alternatively, the drug can take the transcellular route, passing directly through the skin cells themselves. In this case, the drug moves through the lipid bilayers of the cells, entering a more water-soluble environment before reaching deeper layers of the skin [8–14].

LITERATURE SURVEY

Sayali S. S. et al. (2024). To relieve the symptoms of varicose veins, this research study describes the creation and characterisation of an herbal oil that uses anti-inflammatory plant extracts. Ginger oil, garlic, turmeric, olive oil, mustard oil, peppermint oil, castor oil, eucalyptus oil, and guggul powder are all combined in this formulation to create a synergistic blend that targets varicose veins [11].

Jeevan R. Rajguru et al. (2023). The significance of natural products like *Vitex negundo* in the creation of novel therapeutic agents for the control of inflammation is highlighted by this study. The gel and latex formulations' anti-inflammatory properties open the door for more clinical testing to verify the medicines' effectiveness and safety [5].

Swami A. et al. (2023). According to the study's findings, the herbal gel formulation made from *Vitex negundo* leaves' aqueous extract exhibits encouraging outcomes in terms of stability, anti-inflammatory efficacy, and physicochemical characteristics. The mixture may be created as a natural treatment for inflammatory diseases, such as skin irritations, muscle soreness, and arthritis.

Bolisetty P. et al. (2023). This study focuses on the formulation for analgesic and anti-inflammatory herbal oil using *Vitex negundo*, *Senna occidentalis*, *Moringa oleifera*, *Azadirachta indica* and *Sesamum indicum*. According to the study's findings, there are no unfavourable side effects when utilizing herbal oil as an alternative therapy for pain and inflammation.

Shinde M. B. et al. (2023). Sesame oil and a few herbs, including Bala, Akkalkara, Atibala, Brahmi Ashwagandha, and Ambadi, have been shown in this study to have pharmacological use in the management and avoidance of muscle soreness. According to the phytochemical examination, the pain relief oil contains a lot of common phytochemical constituents, including sterols, tannin, saponin, alkaloids, quinine, amino acids, oil and fat, and gum [9].

Hyun-Dong Cho et al. (2021). Author highlights the use of sweet potato leaves This study identified that SPL effectively suppressed LPS-induced inflammation via inhibition of iNOS expression and the NF- κ B signalling pathway in macrophages. Interestingly, LPS-induced COX-2 expression and PGE2 production were not affected by the treatment of SPL extracts.

Mohammad N. A. et al. (2020). In this study author extracted the essential oil from Tamarind leaves and seeds using Microwave extraction method. Amber-coloured oil was the ultimate result of the extraction. The findings demonstrated that for both tamarind leaf and seed samples, the time required for the generation of oil droplets increased as sample weight increased.

Yashwant K. P. et al. (2022). This review highlights the chemical makeup, bioactive components, and therapeutic qualities of sweet potato leaves Their anti-inflammatory, anti-diabetic, cardio-protective, and antibacterial qualities are all attributed to these bioactive chemical's impacts.

R. Komakech et al. (2019). This study shows that the anti-inflammatory effects of *T. indica* may be due to its ability to inhibit several biological pathways including NF-B activation pathways, and leukotriene biosynthesis while its analgesic activity may be via the activation of the opioidergic mechanism at both the peripheral and central mechanisms of pain generation and inhibition of the prostaglandin pathways.

Kanav et al. (2017). According to the literature, sesame oil has been utilized since ancient times and is significant as a foundation in herbal oil compositions for a range of medicinal applications. because it has all the essential qualities needed for a good basis in oil compositions, including optimum stability.

MATERIALS AND METHODS

Plant Material

Tamarind leaves, Nirgundi leaves and sweet potato leaves were collected from the local region of Sindhudurg, Maharashtra, and were authenticated by Shri Pancham Khemraj Mahavidyalaya, Sawantwadi (Table 1) [9].

Method of Preparation

- Weigh required quantity of Tamarind leaves, Nirgundi leaves.
- and sweet potato leaves and triturate separately into mortar pestle using small bit of water triturate them. Gather the fluid using muslin cloth.
- Collect the leaf extract.
- In borosilicate glass beaker heat 32 ml sesame oil and add the extract of triturated leaves and boil until water gets evaporated.
- After the evaporation of water, let the oil cool down at room temperature and filter it using muslin cloth.
- Add eucalyptus oil and clove oil when oil is completely cool down.
- Transfer this oil into airtight container and store in cool and dark place.

Table 1. Designed formulation table (50 ml).

S.N.	Ingredients	ml	Role
1	Tamarind Leaves	5.49 ml	Anti-inflammatory.
2	Nirgundi leaves	5.49 ml	Analgesic.
3	Sweet Potato leaves	5.49 ml	Anti-inflammatory.
3	Eucalyptus oil	1.0 ml	Fragrance.
4	Clove oil	1.0 ml	Preservative.
5	Sesame oil	32 ml	Moisturizing oil.

EVALUATION TEST

Organoleptic Evaluation

Physical state, color, odor, solubility, and texture were among the parameters that were noted and examined and recorded [10].

Physical Evaluation

- *pH Determination*: Prepare 1% w/v solution of sample in distilled water, mix it properly. Measure the pH with pH meter at $27^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Read the pH when temperature and pH reading remains constant on display.
- *Viscosity Determination*: Viscosity is measured using an Ostwald viscometer, where the time taken for a liquid to flow between two marks (A and B) in the capillary tube is recorded. The procedure involves filling the viscometer with water and timing its flow between the marks, followed by repeating the process with the test liquid. The viscosity of the test liquid (η_1) is calculated using the formula:

$$\eta_1 = \frac{\rho_1 t_1}{\rho_2 t_2} \times \eta_2$$

where

- ρ_1 = Density of the unknown liquid.
- t_1 = Flow time of the unknown liquid.
- ρ_2 = Density of the standard liquid.
- t_2 = Flow time of the standard liquid.
- η_2 = Viscosity of the standard liquid.

Acid Value Determination

10 ml of oil was added with 50 ml of ethanol. Phenolphthalein was added as indicator and titrated with 0.1 N sodium hydroxide solution,

- Acid value = 5.61 n/w.
- where, n= Number of ml of 0.1 N NaOH.
- w = Weight of oil.

Saponification Value

2 gm of substance in 250 ml conical flask. Add 25 ml of 0.5 N alc.KOH. Heat the flask on a steam bath, frequently rotating the contents. Add 1ml of phenolphthalein and titrate the excess KOH with 0.5 N HCl. Perform blank determination.

Formula for saponification value:

$$[\text{M} \times (\text{V}_b - \text{V}_t) \times \text{N}] / \text{W}$$

where,

- M = molecular wt of KOH, i.e., 56.11.
- V_b = volume of 0.5N HCl consume in the blank test (ml).
- V_t = volume of 0.5 N HCl consume in the actual test (ml).
- N = exact normality of HCl.
- W = weight of the substance taken for the test (gm).

Specific Gravity

First, weigh the empty specific gravity container (B) to find the oil's specific gravity. After that, add a known amount of oil to the bottle and weigh it once again (A). Subtract the weight of the empty bottle from this measurement to determine the weight of the oil. The bottle should then be emptied, filled with water, and weighed (C). Subtract the weight of the empty bottle from this measurement to determine the weight of the water.

$$\text{Specific Gravity} = (\text{A} - \text{B}) / (\text{C} - \text{B})$$

- *Skin Irritation Test:* Skin irritation was assessed by hand. To check for skin irritation, oil was applied to the hand and left in the sun for five minutes.
- *Skin Penetration Test:* A tiny amount of herbal oil should be applied and gently massaged into a clean, small patch of skin to conduct a skin penetration test. Watch for any reactions as you let it absorb for a few to an hour. After that, look for redness or inflammation; if there are no adverse reactions, the penetration is safe [11].

RESULT AND DISCUSSION

The herbal anti-inflammatory oil was prepared and following result was obtained.

Organoleptic Evaluation

- *Physical State:* Liquid.
- *Colour:* Green.
- *Odour:* Characteristic.
- *Solubility:* Soluble in non-polar solvents.
- *Texture:* Greasy.

Skin Irritation Test

It was discovered that the skin was not inflamed after a tiny amount of the oil was applied and allowed to sit for a while (Table 2).

Table 2. Physical evaluation.

S.N.	Parameter	Result
1	pH	5.28
2	Viscosity	0.91cP
3	Acid Value	1.41
4	Saponification value	181.33
5	Specific gravity	0.85

Skin Penetration Test

Depending on the degree of penetration shown during the test, the outcome of the oil skin penetration test would reveal information on how well the oil is absorbed by the skin and its possible effects on skin health.

DISCUSSION

The evaluation test results fall within the predetermined ranges. The oil has a characteristic odour and is light green in color. The physical parameter results, such as specific gravity, PH, acid value, and saponification value, are in accordance with the accepted standards. When tested on human skin for biological evaluation, it did not cause any allergic reaction.

CONCLUSIONS

When combined with tamarind leaves and nirgundi leaves, sweet potato leaves further enhance the anti-inflammatory and pain-relieving benefits. Tamarind leaves work to reduce inflammation with their rich antioxidant and anti-inflammatory properties, effectively soothing swelling and discomfort in conditions like arthritis and joint pain. Nirgundi leaves provide potent analgesic effects, helping to alleviate pain, especially from musculoskeletal issues, by targeting muscle and joint pain through compounds, like alkaloids and terpenoids, and it also useful to treat gout. Sweet potato leaves, packed with vitamins and antioxidants, complement these oils by promoting healing and further reducing inflammation. Combining sweet potato, nirgundi, and tamarind leaf oils has a synergistic effect whereby the oils enhance one another's therapeutic qualities. The anti-inflammatory, analgesic, and antioxidant properties of each oil are distinct, and when used in combination, they offer more potent and all-encompassing relief than when used separately. This improved activity aids in more efficient pain and

inflammation management. The goal of this study is to create an affordable, simple-to-apply herbal oil with the anti-inflammatory and analgesic qualities of nirgundi, sweet potato, and tamarind leaves. By using natural substances that are kind to the skin and devoid of dangerous chemicals, the composition will quickly reduce pain and inflammation with few adverse effects. The product will be provided to a broad spectrum of customers by emphasizing conveniently available and reasonably priced raw components. Fast absorption, instant alleviation, and convenience of use for everyday uses are all features of the oil's design. The goal of this study is to offer a natural, safe, and cost-effective substitute for synthetic painkillers.

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