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FORMULATION AND EVALUATION OF A HERBAL GEL CONTAINING BOSWELLIC ACID AND TURMERIC FOR ARTHRITIS RELIEF

A Natural Approach to Arthritis Relief

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Abstract: Arthritis, particularly rheumatoid arthritis, is a widespread condition that leads to joint pain, stiffness, and limited mobility. Conventional therapies, such as NSAIDs, are widely used, but they frequently have unfavorable side effects. Natural remedies with lower hazards are therefore becoming more popular. In order to reduce inflammation and hydrate the skin, ArthoHerb Gel, a topical herbal gel that contains boswellic acid, curcumin, and aloe vera, was developed and evaluated. The gel was created with sophisticated extraction methods to guarantee optimal effectiveness with Carbopol 940 as the gelling agent. The finished product had pleasant properties, such as a pH that was good for skin, a smooth texture, good spreadability, and no irritation of the skin. ArthoHerb Gel shows promise as a natural alternative for arthritis relief, with potential for further clinical validation.

Key words: Arthritis, Boswellic Acid, Curcumin, Herbal Gel, Anti-inflammatory

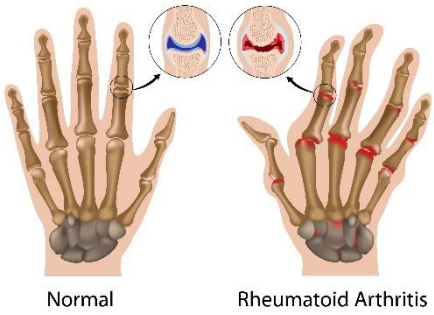

Figure 1: Rheumatoid Arthritis

1. Introduction

Rheumatoid arthritis (RA) is a long-term autoimmune condition that primarily affects the joints, leading to swelling, stiffness, pain, and limited joint movement due to synovial inflammation. Persistent inflammation may result in bone and cartilage deterioration, causing joint malformations and functional impairments. According to Wang et al. (2011), RA affects over 60 million adults worldwide and is associated with an increased risk of mortality. While there is no cure, treatment strategies focus on managing symptoms, slowing disease progression, and improving patients' quality of life (2,3).

1.1 Limitations of Conventional RA Treatment

Nonsteroidal anti-inflammatory drugs (NSAIDs) are widely used as a first-line treatment for RA due to their ability to reduce inflammation and alleviate pain. However, extended NSAID consumption can lead to significant side effects such as digestive ulcers, internal bleeding, increased blood pressure, stroke risks, and kidney-related issues (3). Given these limitations, researchers have been actively exploring natural, botanically-derived compounds that offer similar therapeutic benefits with potentially fewer side effects.

1.2 Herbal Alternatives for RA Management

Boswellic acid, derived from *Boswellia serrata*, and curcumin, obtained from *Curcuma longa* (turmeric), are two notable natural alternatives for RA treatment.

Boswellic Acid: Known for its anti-inflammatory and anti-arthritic properties, boswellic acid inhibits 5-lipoxygenase (5-LOX), a key enzyme in the inflammatory pathway. This mechanism helps reduce joint inflammation and cartilage degradation (4,5).

Curcumin: Exhibits anti-inflammatory, antioxidant, and chondroprotective effects, which can help slow cartilage breakdown and improve joint health (4,1,6).

1.3 Rationale of the Study

While both curcumin and boswellic acid have been separately analysed for their therapeutic effects in rheumatic disorders [1,2], their combined effects in a topical formulation for arthritis have not been thoroughly explored. Therefore, the objective of this study was to develop and evaluate an anti-arthritis cream incorporating both boswellic acid and curcumin as active ingredients. This study aims to determine whether a synergistic effect exists between these two bioactive compounds in reducing joint inflammation and pain when applied topically.

1.4 Active Pharmaceutical Ingredients (APIs) and Their Therapeutic Role

ArthoHerb Gel comprises key herbal active ingredients—Boswellia serrata (Shallaki), Curcumin from *Curcuma longa*, and Aloe vera—which exhibit potent anti-inflammatory and analgesic properties. These ingredients play a vital role in managing arthritis and joint pain through synergistic therapeutic actions.

Boswellia serrata (Shallaki) is a medium-sized deciduous tree native to India and nearby regions, commonly referred to as Indian Frankincense. Its gum-resin contains boswellic acids, essential oils, and terpenoids, which inhibit the 5-lipoxygenase enzyme, thereby reducing leukotriene synthesis and inflammation [11][14][2]. Clinically, Boswellia has demonstrated efficacy in reducing pain, swelling, and improving mobility in osteoarthritis [9][10][7]. In ArthoHerb Gel, Shallaki provides long-term joint protection by preventing cartilage degradation and alleviating pain at the application site.

Curcumin is a bioactive compound derived from the rhizomes of *Curcuma longa* (turmeric). Rich in curcuminoids and essential oils, it exerts anti-inflammatory effects by inhibiting COX-2, NF-κB, and TNF-α pathways [1][12][6]. Its antioxidant properties protect joint tissues from oxidative stress and promote collagen synthesis. Curcumin has shown comparable efficacy to NSAIDs in clinical trials with fewer adverse effects [3][5][7]. In ArthoHerb Gel, it aids in reducing joint stiffness, accelerates tissue repair, and delivers rapid anti-inflammatory action.

Aloe vera is a succulent herb well-known for its soothing, moisturizing, and penetration-enhancing properties. Its gel contains polysaccharides like acemannan, vitamins (A, C, E, B-complex), minerals (Ca, Mg, Zn), and enzymes that collectively exert anti-inflammatory and antioxidant effects [18][19]. Aloe vera enhances the absorption of active ingredients through the skin while providing hydration and cooling to inflamed areas. In ArthoHerb Gel, Aloe vera serves as a natural base, improving formulation aesthetics and therapeutic efficacy by enabling deeper drug delivery.

Aim: To formulate a herbal gel that helps reduce arthritis symptoms.

Objectives of the Study

The primary objective of this study is to formulate and evaluate a topical herbal gel containing Boswellic Acid, Curcumin, Menthol, and Camphor for arthritis pain relief. The study aims to:

1. Develop an optimized herbal gel formulation that combines Boswellic Acid, Curcumin, Menthol, and Camphor for anti-inflammatory and analgesic effects (9,11).
2. Improve bioavailability and skin penetration of Boswellic Acid and Curcumin through a topical gel system, addressing limitations of oral administration (8).

3. Evaluate physicochemical properties such as pH, viscosity, spreadability, stability, to ensure optimal gel consistency and therapeutic effectiveness (7).

2. EXPERIMENTAL

I. Materials

Table 1: List of instruments used

NAME	MODEL
Linear Motion Shaker	RM 8 (SPECTRALAB)
Rotary Vacuum Evaporator	----
Homogenizer	—
Brookfield Viscometer	CAP 2000+

Table 2: Ingredients used (formula)

NAME	QUANTITY (for 100g)		FUNCTION
Shallaki (Boswellia serrata) Extract	2g		Anti-inflammatory agent
Aloe Vera Gel (Fresh + Vitamin E)	20g		Soothing & skin hydration
Turmeric Extract (Curcumin 95%)	1g		Anti-inflammatory & antioxidant
Peppermint Oil	1g		Cooling effect & pain relief
Carbopol 940 (pre-soaked)	1g		Gelling agent
Propylene Glycol (PG)	5g		Humectant & solvent
Glycerin	5g		Moisturizer & humectant
Methylparaben & Propylparaben	0.2g		Preservative
Triethanolamine (TEA)	q.s.		pH Adjuster
Distilled Water	q.s. to make 100g		Solvent

II. Methodology

2.1 Extraction of Active Ingredients: The extraction of active ingredients from Shallaki (Boswellia serrata), Turmeric (Curcuma longa), and Aloe vera was carried out using appropriate techniques to ensure maximum potency and bioavailability. The process involved solvent-based extraction, heat-assisted extraction, and mechanical separation methods.

Extraction of Boswellic Acid (Shallaki Extract): Boswellic acids were extracted from *Boswellia serrata* (Shallaki) gum resin using an ethanolic solvent system, followed by concentration under reduced pressure to obtain a semi-solid phytoconstituent-rich extract [2][11][14]. The process commenced with pulverization of the dried Shallaki gum resin

to a fine powder to enhance extraction efficiency [14][15]. The powdered material was subjected to maceration with ethanol in a mechanical shaker for 5 hours daily over a period of 2 days to ensure exhaustive extraction of the active principles [2]. The resultant extract was subsequently filtered using vacuum-assisted filtration to remove residual plant debris and insoluble matter. The clarified filtrate was concentrated using a rotary vacuum evaporator under controlled temperature (to prevent thermal degradation) for 3 to 4 hours, facilitating solvent removal [10][11]. The viscous concentrate was then subjected to mild drying in a petri dish at 37°C for 1 hour, yielding a semi-solid Boswellic acid-rich extract, suitable for formulation into the ArthoHerb Gel matrix [7][9][11]**.**

Fig 2: Shallaki extraction using ethanol.

Fig. 3: Concentration via rotary evaporator.

Fig. 4: Semi-solid Shallaki extract

Extraction of Curcumin: Curcumin extraction was conducted using coconut oil as a green solvent to enhance its solubility and bioavailability. Turmeric powder was first transferred to a clean petri plate to minimize contamination. The powder was then mixed with coconut oil in a conical flask. Heat-assisted extraction was performed by heating the mixture in a water bath at 60–70°C for 3–4 hours, promoting curcuminoid diffusion into the oil phase. Afterward, the mixture was filtered to remove the residual solids. The curcumin-rich coconut oil extract was then stored in an airtight container at a controlled temperature to prevent oxidation and degradation.

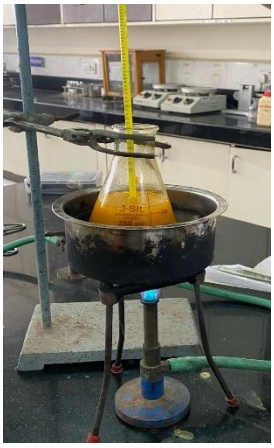

Fig. 5: Heat-assisted extraction

Extraction of Aloevera gel: Aloe Vera gel was freshly extracted from *Aloe barbadensis* leaves and stabilized using Vitamin E to preserve its therapeutic efficacy. Initially, the leaves were thoroughly washed with distilled water to eliminate dirt and surface impurities. The leaves were then cut open, and the inner mucilaginous gel was carefully scooped out using a sterile spatula. The gel was subsequently filtered to remove fibrous materials and debris, resulting in a clear, smooth extract. To enhance the stability and prevent oxidative degradation of the bioactive compounds, Vitamin E was incorporated into the gel. The stabilized Aloe Vera gel was finally stored in an airtight container under cool and dark conditions to retain its biological activity for subsequent formulation.

2.2. Formulation of ArthoHerb Gel: ArthoHerb Gel was formulated through a systematic phase-wise procedure to ensure the optimal incorporation of all ingredients and to obtain a stable gel matrix. The process commenced with the preparation of the gel base, where Carbopol 940 (1%) was dispersed in distilled water and allowed to hydrate for 24 hours, facilitating complete swelling of the polymer. Subsequently, humectants such as glycerin and propylene glycol were dissolved in distilled water, followed by the addition of preservatives (methylparaben and propylparaben), and this solution was gradually incorporated into the gel base under continuous stirring for homogeneity. In the second phase, active ingredients were introduced sequentially. Shallaki (Boswellia serrata) extract was dispersed in peppermint oil to enhance its solubility and therapeutic effect, while curcumin extract (95%) was solubilized in glycerin to improve its bioavailability and stability. Fresh Aloe Vera gel, pre-stabilized with Vitamin E, was then incorporated with continuous stirring to ensure even distribution. The final step involved pH adjustment using Triethanolamine (TEA) to achieve a skin-compatible pH range of 5.5–6.5. The formulation was homogenized using a mechanical stirrer operating at 200–300 rpm until a smooth, lump-free gel was obtained. The final product was transferred into airtight containers and stored at ambient temperature under controlled conditions until further evaluation.

Fig. 6: Final ArthoHerb Gel formulation.

3. Evaluation of arthoherb gel

The ArthoHerb Gel was subjected to various physicochemical and functional evaluation tests to ensure its quality, stability, and effectiveness. The evaluation parameters included homogeneity, color, odor, pH measurement, viscosity, spreadability, and patch testing.

3.1 Homogeneity Test

The homogeneity test was performed to assess the uniformity and consistency of the gel formulation. A small quantity of the gel was taken and rubbed between the fingers to detect any lumps or grittiness. Additionally, the gel was visually

examined for any signs of phase separation or uneven texture. The formulation was considered homogeneous as it appeared smooth and consistent, with no phase separation detected.

3.2 Color and Odor Test

The color and odor test was carried out to evaluate the physical appearance and organoleptic characteristics of the gel. The color of the gel was observed under natural daylight to check for uniformity and appeal. The odor was assessed by sniffing a small sample of the gel to ensure it exhibited a pleasant and characteristic peppermint fragrance, free from any rancid or undesirable smell.

3.3 pH Measurement

The pH measurement was conducted to ensure skin compatibility and formulation stability. A small amount of the gel was tested using pH paper, and the pH was found to be within the range of 5.5 to 6.5. This range is suitable for topical applications as it aligns with the natural pH of the skin.

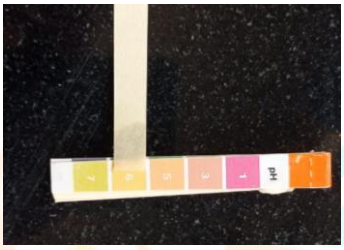

Fig. 7: pH test

3.4 Viscosity Measurement

The viscosity measurement was performed using a Brookfield Viscometer (Model: CAP 2000+). Spindle number 01 was used at a speed of 50 rpm with a shear rate of 667, and the measurement was taken for 1 minute at a temperature of 26-27°C. The procedure was repeated three times for consistency and accuracy. The gel exhibited moderate viscosity, providing ease of application without being excessively runny.

Fig. 8: Brookfield viscometer

Fig. 9: Gel viscosity test on Brookfield viscometer

3.5 Spreadability Test

The spreadability test was conducted to determine the ease of spreading the gel over the skin surface. A pre-marked glass slide was placed on a flat surface, and 1 gram of the gel was placed at the center. Another glass slide was placed on top, and a 50 g weight was applied for 1 minute. The upper glass slide displaced by 5 cm within 10 seconds. Spreadability (S) was calculated using the Equation 1.

$$S = \frac{M \times L}{T}, \qquad (1)$$

where M is the applied weight, L is the length of spread, and T is the time taken. The gel exhibited good spreadability, allowing smooth application without excessive dripping.

Fig. 10: Spreadability apparatus

3.6 Skin Irritation (Patch Test)

The skin irritation (patch test) was conducted to evaluate the dermal safety of the formulation. A 1 × 1 cm square of the gel was applied to the back of the user's hand and left for a few minutes. The area was monitored for any signs of redness, itching, or irritation. No adverse reactions were observed, indicating that the gel is safe for topical use.

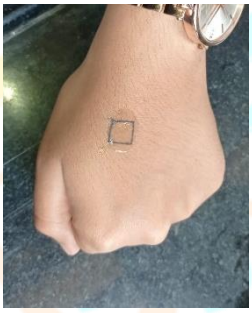

Fig. 11: Skin irritation test

3. RESULT:

The prepared anti-arthritis gel was evaluated for various parameters and was found to meet the required characteristics. The formulation exhibited desirable properties such as smooth texture, good spreadability, and an acceptable pH.

Table 3: Physicochemical evaluation of formulated gel.

SR. NO.	EVALUATION PARAMETERS	RESULTS
1.	Color	Light yellow
2.	Odor	Characteristic peppermint smell
3.	pH	5.5 - 6.0
4.	Viscosity	7.862P
5.	Spreadability	20 g cm/sec
6.	Skin Irritation Test	No irritation observed
7.	Appearance & Consistency	Smooth, uniform, and non-sticky
8.	Stability	Stable at room temperature

4. CONCLUSION:

ArthoHerb Gel was successfully developed as a topical herbal formulation combining Boswellic acid, Curcumin, and Aloe vera. The formulation was designed to potentially offer anti-inflammatory and soothing effects, supported by the known properties of the selected herbal extracts. The gel exhibited favorable physicochemical properties, including a skin-compatible pH, appropriate viscosity, and good spreadability, ensuring smooth application and patient compliance.

In addition, the formulation was found to be non-irritant upon preliminary skin testing, indicating its safety for topical use.

While these initial results demonstrate that the formulation is stable and suitable for skin application, further studies will be necessary to evaluate its therapeutic potential and long-term stability. Overall, ArthoHerb Gel shows promise as a natural topical preparation and provides a basis for further research and development in herbal anti-arthritis therapies.

DISCUSSION: The study's findings show that ArthoHerb Gel, which is made with aloe vera, curcumin, and boswellic acid, has advantageous physicochemical qualities for topical use. Compatibility and less irritation are ensured by the pH of 5.5–6.0, which is in line with the skin's natural pH. The gel's spreadability of 20 g cm/sec and viscosity of 7.862P make application simple and user-friendly. Its safety for topical application is further supported by the fact that patch testing revealed no skin irritation.

In line with earlier research, the gel's combination of boswellic acid and curcumin has a synergistic anti-inflammatory impact. Curcumin has chondroprotective and antioxidant properties by modulating the COX-2 and NF-κB pathways, while boswellic acid reduces inflammation by inhibiting 5-lipoxygenase. These results are consistent with those of Haroyan et al. (2018), who conducted a randomized controlled study and found comparable anti-inflammatory benefits.

This study shows ArthoHerb Gel's promising potential as a safe and efficient arthritis treatment formulation. In addition to demonstrating great physicochemical qualities—such as a pH that is skin-compatible, ideal viscosity, and superior spreadability—the gel also demonstrated safety in early skin irritation tests. Its therapeutic potential and usefulness as a long-term substitute for traditional treatments will be further confirmed by upcoming clinical trials and long-term stability investigations.

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