

Development and preparation of herbal Gel using *Turmeric*, *Moringa Olifera* and *Tridax procumbens* for wound healing purpose with their evaluation parameters

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Abstract

Herbal gels are a key focus of modern pharmacology due to their ease of use, biocompatibility, and less adverse effects compared to synthetic formulations. Because of their well-established therapeutic properties, such as wound healing, antibacterial, anti-inflammatory, and antioxidant activity, medicinal plants like *Tridax procumbens*, *Moringa olifera*, and *Curcuma longa* (turmeric) are utilized in topical gel compositions. The purpose of this review was to synthesize and describe turmeric herbal gel, *Moringa olifera*, and *Tridax procumbens* for the administration of tropical medications. to evaluate the stability and physicochemical properties of the herbal gel. The rhizomes of turmeric plants were gathered from the Samarth Rural Educational Institution on the Samarth Gurukul campus, while *Tridax procumbens* and *Moringa olifera* plants were gathered from nearby residents.

The gathered plant material was properly cleaned of debris by running tap water. After that, it was left to thoroughly dry at room temperature, being sure to reduce impurities by drying it in the shade for three to four weeks. After drying, a grinder was used to grind the material into a fine powder. Prior to usage, the color, texture, and odor of this powder were assessed as quality features. Triethanolamine was gradually added during the formulation process to keep the mixture's pH at the appropriate level. Important physicochemical characteristics of the resultant formulations, including pH, viscosity, and spreadability, were then measured. Because they reduce the adverse side effects that synthetic pharmaceuticals frequently induce, herbal therapies are typically thought to be safer than allopathic medications.

Keywords: Wound healing; Turmeric Rhizomes; *Tridax Procumbens*; *Moringa Olifera*

1. Introduction

Traditional medicines have been used for hundreds of years in India and are a useful treatment because of their implicit effects on a variety of illnesses and ailments. Although we are concerned about the importance of traditional pharmaceuticals, there are drawbacks as well, such as a lack of research, a paucity of literature, and low case compliance with traditional drugs. According to certain print media outlets, 77 percent of Indian households utilize herbal ayurvedic products. In India, there are several stores that sale medical supplies. The plant *Tridax procumbens*, often known as *Tridax daisy*, is a member of the *Asteraceae* family and the *Tridax rubric*. This plant is widely distributed throughout the country, whether it is tropical or not. In Maharashtra's pastoral areas, growers, laborers, and other individuals involved in the tilling profession use it for a wide range of purposes. An important member of the *Moringaceae* family, this plant is used in food and medicine all around the world. Its medical qualities which include wound healing, antioxidant, antimicrobial, antidiabetic, and Anticancer characteristics, to mention a few have earned it the nickname "miracle tree" or "Tree of Life."

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"Turmeric, or *Curcuma longa*, was chosen for this study because of its anti-inflammatory qualities and high flavonoid concentration. Because they are less expensive and have fewer adverse effects, herbal drugs are becoming more and more well-known worldwide. They are crucial because of their substantial benefits to health, especially in relation to diet and general well-being. Creating and testing a herbal gel with extracts from turmeric, *Tridax procumbens* rhizomes, and *Moringa oleifera* leaves is the aim of this review.

1.1. Rationale for herbal Gels

1.1.1. Advantages

- Low side effects and safe.
- Improved feel and texture.
- Fit for skin that is sensitive.
- Antimicrobial and anti-inflammatory qualities.
- increased stability

1.1.2. Disadvantages

- A delayed start to action
- The possibility of allergic responses or discomfort.
- The possibility of contamination
- Quality assurance and standardization
- A problem with stability

1.1.3. Scope-

The synergistic benefits of the individual qualities of turmeric, *Tridax procumbens*, and *Moringa oleifera* make a combined herbal gel containing these three plants very promising for improved wound healing. Although the medicinal properties of each plant are well recognized, combining them can result in a more effective and thorough treatment. Work on such a polyherbal gel is necessary because it has the potential to be a safe, practical, and affordable substitute for synthetic wound care solutions.

Traditional Validation: Traditional Indian medicine has long used *Moringa oleifera* and *Tridax procumbens* to treat wounds.

Natural Alternative: This study is still relevant in the twenty-first century since there is a growing interest in creating natural, plant-based medicines to lessen the negative effects of synthetic pharmaceuticals. **Cost-Effectiveness:** Herbal remedies may be a less expensive way to treat wounds.

Aim

The gel is intended to accelerate the rate at which the wound contracts and shorten the time required for the wound to be covered by new epithelial tissue, a process known as re-epithelialization. Utilizing those herbs, Reduce the disadvantages of the gel that is already available on the market.

Objectives

- Establishing a stable formulation.
- Promoting tissue regeneration.
- Proving wound-healing effectiveness; and preventing infection.
- Develop a stable formulation.
- Wound Healing: Mechanism and management-

Wound healing is the body's natural physiological reaction to tissue damage. However, wound healing is a complex process that includes interactions between the vascular system, cytokines, mediators, and several cell types. Current wound healing research focuses on identifying target genes that can be enhanced at the molecular level to speed up natural wound healing.

1.2. The Four Phases of Wound Healing-

- Hemostasis (Coagulation): blood vessels constrict to stop bleeding incontinently after injury. Platelets aggregate at the site of the fracture to create a clot, which halts the bleeding and creates a foundation for the subsequent stage.
- Inflammation: This stage, which starts within the first 24 hours, is marked by pain, heat, swelling, and redness. To remove debris, bacteria, and damaged cells, immune cells such as neutrophils, monocytes, and macrophages enter the breach. Additionally, these cells release growth factors and cytokines that signal the next step of healing.
- Proliferation: Fibroblasts are recruited to the crack point and new blood vessels are formed. The connective tissue that creates the new tissue, collagen, is made by fibroblasts. A process known as epithelialization occurs when epithelial cells migrate across the crack face, sealing the crack.
- Development (Remodeling): This is the last and longest stage, which can go on for months or even years. In order to improve tensile strength, collagen is restructured and cross-linked. As the new tissue develops, a scar forms, but one that is not as robust as the original skin.

1.3. Phases of wound healing

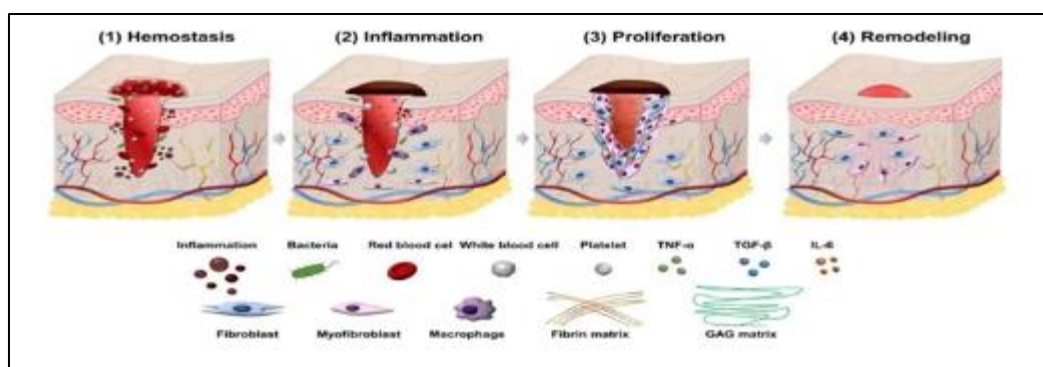


Figure 1 Illustration of four phases in the wound healing process

1.4. Factors Affecting Wound Healing-

- Cellular and Molecular Mediators: Cytokines and growth factors are essential for controlling the process.
- Extracellular Matrix (ECM): Throughout the healing process, the ECM undergoes modifications as the framework on which cells multiply and tissue regenerates.
- Biological Factors: The age, nutritional level, and underlying medical issues of a patient can all affect how quickly they heal.
- External Factors: Clinical results and the avoidance of complications are influenced by optimal wound care, which includes the use of suitable therapies.

1.5. Pharmacological And Phytochemical Profile of Selected Herbs-

1.5.1. Selected Herbs

Tridax procumbens, Moringa oleifera, and turmeric (*Curcuma longa*) are used to make a herbal gel. These plants are chosen for their well-established therapeutic qualities, especially in the areas of wound healing, anti-inflammatory, antimicrobial, and antioxidant activities, which make them appropriate for topical applications like gel.

1.5.2. Plant Materials:

- Turmeric rhizomes (fresh or dried).
- Moringa oleifera leaves (fresh or dried).
- Tridax procumbens leaves (fresh or dried).

1.6. Plant Profile

1.6.1. Turmeric plant

Turmeric is a perennial herbaceous plant that is used extensively as a spice, dye, and medicinal herb because of its orange-yellow rhizomes. Approximately one meter (3 feet) in height, the plant has long, oblong leaves and pale-yellow flowers that emerge from a spike in the shape of a funnel.

Medicinal: Contains curcumin, known for anti-inflammatory and antioxidant properties; used in traditional medicine for digestion, skin health, and wound healing.



Figure 2 Turmeric Rhizomes

- Botanical name – *curcuma longa*
- Kingdom – plantae
- Family- zingiberacea
- Genus – *curcuma*
- Common name – turmeric, golden spice
- Class -Liliopsida
- Order-zingiberales

Table 1 Characteristics and Properties of Turmeric Plant

Source	-The substance was extracted from the rhizomes of the perennial plant turmeric (<i>Curcuma longa</i>).
Pharmacological Properties	- Anti-inflammatory - Antioxidant - Anticancer (potential) - Antimicrobial - Neuroprotective (potential)
Therapeutic Uses	- Arthritis management - Digestive disorders - Cancer prevention - Alzheimer's disease (under study) - Wound healing
Chemical constituents	60–70% carbohydrate, 6–8% protein, 5–10% fat, 3–7% minerals (potassium, sodium, calcium, iron)

1.6.2. *Moringa olifera*

Originally from northern India, *Moringa oleifera*, also referred to as the "drumstick tree," "horseradish tree," or "miracle tree," is a drought-resistant, quick-growing plant that is now widely grown in tropical and subtropical climates across the world. addressing pain, ulcers, wounds, and inflammation (for example, using leaf poultices to treat bronchitis, headaches, or glandular swelling). Handling digestive disorders such as colitis, dysentery, and diarrhoea.



Figure 3 *Moringa Oleifera*

- Botanical Name: *Moringa oleifera*
- Kingdom: Plantae
- Order: Brassicales
- Family: Moringaceae
- Genus: *Moringa*
- Class: *M. Oleifera*
- Common Name: Drumstick tree, Shevga

Traditional and Medicinal Uses-

- In traditional medicine systems, such as Ayurveda, moringa is reported to address a wide range of conditions. Modern research is exploring its potential benefits, which include:
- Antioxidant and Anti-inflammatory properties.
- Potential to help lower blood sugar levels and cholesterol in some studies.
- Support for liver protection and fighting bacterial infections.
- Used to combat malnutrition in developing nations due to its high nutrient density.

Nutritional Value-

- Leaves (most commonly used): They are exceptionally nutritious, often used fresh or dried and powdered.
- High in protein (unusually high for a plant), including all 9 essential amino acids.
- Rich in essential vitamins such as Vitamin A (Beta-carotene), Vitamin C, Vitamin E, and various B vitamins (like B1, B2, B6).
- A significant source of minerals like calcium, potassium, iron, and magnesium.
- Contain a high level of antioxidants (e.g., quercetin, chlorogenic acid).

Table 2 Characteristics and Properties of *Moringa Oleifera*

Common Names	Drumstick tree, Horseradish tree, Ben oil tree, Miracle tree
Nutritional Content (Leaves)	Rich in vitamins (A, C, E), minerals (calcium, potassium, iron), protein, antioxidants
Medicinal Uses	Anti-inflammatory, antioxidant, antidiabetic, antimicrobial, supports heart health
Nutritional Content (Seeds)	Fat: 21.4 g/100 g (rich in oleic acid) - Protein, iron, calcium (used for fortification in flours) - Bitter flavor, used in sauces or fried as snacks in Nigeria

1.6.3. *Tridax procumbens*

Tridax procumbens is a multipurpose medicinal herb that has been shown to have both traditional and pharmacological benefits, especially for liver health, inflammation, and infections. The plant, which has yellow daisy-like flowers and

lobed leaves, usually grows to a height of 10 to 40 cm. It is well known in traditional medical systems, especially Ayurveda in India, where it is sometimes called "Bhringraj" and used as an anticoagulant, for wound healing, and for liver diseases



Figure 4 Tridax Procumbens

- Botanical Name: *Tridax procumbens*
- Kingdom: Plantae
- Order: Asterales
- Family: Asteraceae
- Genus: Tridax
- Species: *T. procumbens*
- Synonym: Dagadipala, Kabarmodi

Table 3 Characteristics and Properties of Tridax Procumbens

Common Names	-Coatbuttons, Tridax Daisy, Mexican Daisy, Pardesi Bhangaro, Ghamra (Hindi), Kansari (Hindi), Ghajadvu/Ghaburi (Gujarati), Bikhalyakarani (Assamese), Jayanti Veda/Avanti (Sanskrit),
Traditional Uses	-Wound healing, anticoagulant, antifungal, insect repellent, treatment for infectious skin diseases, bronchial catarrh, diarrhea, dysentery, malaria, high blood pressure, backache, colds, flu, and to check hemorrhage from cuts
Pharmacological Properties	-Antioxidant, anti-inflammatory, anti-cancer, neuroprotective, hepatoprotective anti diabetic etc.
Chemical Constituents	-Flavonoids (e.g., procumbenetin, 7,8-DHF, catechins, centaurein, bergenins), alkaloids (8.5% in leaf extract), sterols, fatty acids, glycerides, triose sugar alcohols, pentacyclic triterpenes, polysaccharides, essential oils, saponins, tannins, carotenoids, minerals

A combined herbal gel containing turmeric, Tridax procumbens, and Moringa oleifera holds significant promise for enhanced wound healing due to the synergistic effects of their individual properties. While each plant is known for its medicinal benefits, combining them can create a more potent and comprehensive treatment.

2. Development and Formulation Considerations of the Herbal Gel

2.1. Material and Methods

2.1.1. Plant Materials

- Tridax procumbens: Fresh or dried leaves, authenticated and collected from a reliable source
- Moringa oleifera: Fresh or dried leaves, preferably sourced .

- Turmeric (*Curcuma longa*): Rhizome powder or fresh rhizomes.

2.1.2. Chemicals and Reagents

Solvents for Extraction: Ethanol, methanol, distilled water etc.

Gel Base Components:

- HPMC: Gelling agent to provide viscosity and structure.
- Propylene Glycol: Humectant and solvent to enhance spreadability.
- Triethanolamine: pH adjuster to maintain skin-compatible pH (6.8–7.0).
- Benzyl alcohol: Preservatives to ensure shelf stability.

Equipment

- Maceration setup for extraction.
- Rotary evaporator or vacuum oven for solvent removal.
- pH meter for adjusting gel pH.
- Magnetic stirrer for uniform gel mixing.
- Analytical balance for precise measurements.
- Sterile containers for gel storage.

2.2. Method of preparation

2.2.1. Phase: - 1

Step1-Collection and Authentication of Plant Materials-

Curcuma longa rhizomes were collected from the Samarth Gurukul campus's Samarth Rural Educational Institution. The local area, the nearby area, and our hamlet near Pune in Maharashtra were the sources of the leaves of *Tridax procumbens* (kambarmodi) and *Moringa oleifera* (shevga). The rhizomes and leaves need to be thoroughly washed and dried. Additionally, the physiochemical properties, foaming index, moisture content, and organoleptic characterisation will be examined.

Step 2: Preparation of Plant Extracts

- Drying and Pulverization-

The herbs are dried, cleaned, and then chopped into smaller bits to maximize the extraction surface area. It's crucial to dry the turmeric leaves and rhizomes since excessive moisture can interfere with the extraction process. The herbs should be shade-dried for two to three weeks before being ground into a fine powder.

- Extraction by Maceration:

Depending on the kind of substance, choose the right solvent for the extraction process, such as ethanol, methanol, or water. To increase surface area, cut or dry the leaves of *Tridax procumbens* and *Moringa olifera*, as well as the turmeric rhizomes, into small pieces. Separately place the prepared herb in sanitized glass containers or jars. Cover the plants with enough ethanol to completely submerge them. A typical ratio is between 1:5 and 1:10. After sealing and stirring, let the maceration process run for 7–14 days, shaking the jar gently each day. After that, concentrate and filter the solution.

- Phytochemical Screening-

Lastly, the phytochemical tests of the extracts of turmeric, *Tridax procumbens*, and *Moringa olifera* were conducted, and they were stored in an appropriate manner to ensure their stability.

- Test For Alkaloids-(Mayer's Test) After adding two milliliters of concentrated HCL to around two milliliters of extract, Mayer's reagent was applied drop by drop. The presence of alkaloids is shown by the production of white precipitate.

- Test for Saponin (Foam Test)- Mix 1 gram of the sample material with 10–20 milliliters of water, mix well, and watch for froth to form. The presence of saponins is shown by the foam's stability for a predetermined period of time, such as 60–120 seconds or more.
- Test for Tannins- (Ferric Chloride Test) A brownish green or blue-black colouring, which denotes the presence of tannins, was seen when 0.1% ferric chloride solution was added to 1 milliliter of the extract.
- Test for Terpenoids(Salkowski's Test) -Approximately 1 milliliter of the extract and 2 milliliters of chloroform were obtained, and then 5 milliliters of concentrated H₂SO₄ were added along the test tube sides. Terpenoids are present when a reddish-brown hue forms in the interphase.
- Test for Phenolic Compounds (Bromine water Test)-. Drop by drop, add bromine water after dissolving the organic chemical in a suitable solvent, such as water or glacial acetic acid. The production of a white 2,4,6-tribromophenol precipitate and the elimination of the reddish-brown color of the bromine water suggest a successful outcome.
- Test for Polysaccharides (Molisch's Test)- In a test tube with 2 mL of the sample, add a few drops of Molisch's reagent (alpha-naphthol in ethanol), stir, and then carefully add roughly 1 mL of concentrated sulfuric acid down the side to create a noticeable lower layer. When there is a purple or violet ring at the intersection of the two layers, it indicates the presence of carbs and is a favorable outcome.

Step 3: Preparation of Gel Base

To ensure effective hydration, HPMC must be dissolved in hot water, usually between 70°C and 90°C. Next, add the remaining cold water gradually while swirling constantly, as you would with a magnetic stirrer. A cooling bath, such as a water bath, is made by appropriately mixing the gel basis.

Step 4: Final Mixing and Homogenization-

Following the preparation of the HPMC gel basis, the remaining water was added, followed by the preservative propylene glycol and benzyl alcohol in the leaf extract. To bring the pH down to 7, triethanolamine was then added while being continuously stirred. The last preparation is complete.

2.3. Evaluation Parameters for Herbal Gel

2.3.1. Physicochemical Properties:

- Physical Appearance: Through visual inspection, the color uniformity of each herbal gel formulation was verified.
- pH: A 1% aqueous solution of the generated gel formulations was measured using a pH METER
- Homogeneity: Herbal gel is examined visually. Through visual inspection, the color uniformity of each herbal gel formulation was verified. Keep an eye out for any indications of an uneven distribution of herbal extracts or additions, such as visible particles, color fluctuations, or uneven texture.
- Spreadability: The necessary quantity of sample is placed between two glass slides, and after five minutes, a 1-gram weight is attached to the slides, and the spreadability is examined.
- Viscosity: The measurements of viscosity of the gels was done with DV-I Brookfield viscometer and the corresponding reading was noted.
- Skin Irritation Test Patch Testing: Usually done on the back or forearm, this entails putting a tiny bit of the herbal gel to a small patch of skin and watching for any quick reactions, such as swelling, redness, or itching.
- Washability: Formulation Was applied on skin and then ease of extent washing with water was checked.
- Stability Test: For weeks, the herbal gel's physical stability was assessed at different temperatures, ranging from 2 °C to 37 °C. It was discovered that the herbal gel was physically stable throughout a range of temperatures.

3. Conclusion and Future Perspectives

The well-known antioxidant, anti-inflammatory, and antibacterial qualities of the constituent herbs support the optimistic outcomes of the herbal gel that was created by combining extracts of tridax (*Tridax procumbens*), moringa (*Moringa oleifera*), and turmeric (*Curcuma longa*) for wound healing. Testing physicochemical characteristics such as pH, viscosity, spreadability, homogeneity, and stability to make sure the gel is appropriate for topical application is usually how successful development is verified.

Future Views: Future studies should concentrate on identifying and defining the precise bioactive phytochemicals (such as triterpenoids, flavonoids, and curcuminoids) that have a synergistic effect on wound healing. To confirm the gel's

effectiveness and safety for commercial usage, more clinical research is essential. This includes controlled human trials, in-vitro antimicrobial testing, and in-vivo wound healing investigations (such as excision/incision models). Furthermore, investigating cutting-edge delivery methods like nanoformulations (such as nanogels or nanosponges) may improve the herbal active ingredients' bioavailability, skin penetration, and sustained release, thereby establishing this natural product as a safe and affordable substitute for traditional wound care treatments.

Result:-We performed the formulation and development of herbal gel that ensures that the formulated gel is not only effective in promoting wound healing but is also safe, stable, and acceptable for topical use. We also performed the various evaluation parameters and it gave positive results.

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