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Research Article

Formulation And Evaluation of Gel Containing Wound Healing Activity of Tridax Procubens

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ABSTRACT

Tridax procumbens Linn. Commonly known as “Ghamra” or “Coat Buttons,” is a medicinal plant belonging to the Asteraceae family and widely distributed across India and other tropical regions. Traditionally used in Ayurveda, it exhibits various therapeutic properties such as anti-inflammatory, antimicrobial, hepatoprotective, antidiabetic, and wound healing activities. The plant’s wound healing potential is especially noteworthy, addressing a critical need for effective treatment options for chronic wounds, particularly in diabetic patients. Chronic wounds in diabetes, including diabetic foot ulcers, represent a growing health burden globally, often leading to severe complications such as osteomyelitis and limb amputation.

INTRODUCTION

Tridax procumbens Linn belongs to Asteraceae family. It is commonly known As Ghamra” and in English popularly called „coat Buttons” because of the appearance of flowers. The Plant has been extensively used in Ayurvedic system Of medicine for various disorders. The plant is The innate of tropical America and enfranchised in Tropical Africa, Asia, Australia and India. It is a wild herb distributed throughout India. Coat Buttons is also found along roadsides, waste Grounds, dikes, railroads, riverbanks, meadows, and Dunes. Its widespread distribution and importance As a weed

are due to its spreading stems and Abundant seed production.

Traditional uses

procumbens possesses significant anti-inflammatory, hepatoprotective, wound healing, antidiabetic activity and antimicrobial activity against both gram-positive and gram-negative bacteria. the leaf juice possesses antiseptic, insecticidal and parasitocidal properties and it is also used to check hemorrhage from cuts, bruises and wounds.

Wound Healing Activity

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A wound is defined as an injury to the Body (as from violence, accident, surgery) that Typically involves laceration or breaking of a Membrane such as the skin and usually damage to Underlying tissues. A wound is the breakage of normal alignment of body cells with or without destroying them, which may impair or stop their function. Wound is a breach formed in the normal continuum of the cellular and molecular structure of the body, thereby creating a disruption in the cellular, anatomic and as well as in their functional continuity. Wound healing or wound repair is an intricate process in which the skin or organ or tissue repairs itself after injury Wound can be healed as spontaneous process in the organism through a cascade of events, which starts by switching on various chemical signals in the body. While partial thickness wound heals by mere epithelialization, the healing of full thickness wound which extends through the entire dermis involves more complex well-regulated biological events. Chronic wounds often occur in patients with diabetes mellitus due to the impairment of wound healing. This has negative consequences for both the patient and the medical system and considering the growing prevalence of diabetes; it will be a significant medical, social, and economic burden in the near future. Hence, the need for therapeutic alternatives to the current available treatments that, although various, do not guarantee a rapid and definite reparative process, appears necessary. We here analyzed current treatments for wound healing, but mainly focused the attention on few classes of drugs that are already in the market with different indications, but that have shown in preclinical and few clinical trials the potentiality to be used in the treatment of impaired wound healing. In particular, repurposing of the antiglycemic agents dipeptidylpeptidase 4 (DPP4) inhibitors and metformin, but also, statins and phenytotin have been analyzed. All show encouraging results in the

treatment of chronic wounds, but additional, well-designed studies are needed to allow these drugs. Diabetic patients have a 15-25% lifetime risk of developing diabetic foot ulcers, of which 40-80% become so severely infected it involves the bone, leading to osteomyelitis Global epidemiological studies suggest a higher prevalence in North America . A high number of cases of foot ulcerations require hospitalization and surgical intervention with amputation of the interested body part. In addition, the rate of recurrence of a foot ulcer is greater than 50% after 3 years from the first episode. For this reason, impaired wound healing in DM represents a major healthcare issue and a significant economic burden Notably, costs for diabetic foot ulcerations treatment are and prevalence of pathology.

Cause and Types of wound

Wound causes can be internal or external in origin. Wounds of internal origin are mainly due to impaired circulation, neuropathy or medical illness. Wounds of external origin are due to an outside force or trauma that causes open or closed wounds.

1. Impaired circulation: This can be from either ischemia or stasis. Ischemia is the result of reduced blood supply caused by the narrowing or blockage of blood vessels, which leads to poor circulation, Stasis is caused by immobilization (or difficulty moving) for long periods or failure of the regulating valves in the veins, which leads to blood pooling and failing to flow normally to the heart.

2. Neuropathy: This is seen mostly in cases of prolonged uncontrolled diabetes mellitus, where high blood sugars, derivative proteins and metabolites accumulate and damage the nervous system. The patients are usually unaware of any trauma or wounds, mainly due to loss of sensation in the affected area.



3. Medical illness: When chronic and uncontrolled for long periods (such as hypertension, hyperlipidemia, arthrosclerosis, diabetes mellitus, AIDS, malignancy, morbid obesity, hepatitis C virus, etc.), medical illnesses can lead to impairment of the immune system. Functions, diminishing the circulation and damaging other organs and systems.

4. Contusions: These are a common type of sports injury, where a direct blunt trauma can damage the small blood vessels and capillaries, muscles and underlying tissue, as well the internal organs or bone. Contusions present as a painful bruise with reddish to bluish discoloration that spreads over the injured area of skin.

5. Hematomas: These include any injury that damages the small blood vessels and capillaries. Resulting in blood collecting and pooling in a limited space. Hematomas typically present as a painful, spongy rubbery lump-like lesion. Depending on the severity and site of the trauma, hematomas can be small or large, deep inside the body or just under the skin.

6. Crush injuries: These are usually caused by an external high-pressure force that squeezes part of the body between two surfaces. The degree of

injury can range from a minor bruise to a complete destruction of the crushed area of the body, depending on the site, size, duration and power of the trauma. In cases of open wounds, the skin is cracked open, leaving the underlying tissue exposed to the outside environment.

PLANT PROFILE AND EXCIPIENT PROFILE

1. Plant profile

Tridax Procubens plant Tridax procumbens, commonly known as coat buttons or Tridax daisy, is a medicinal plant widely used in traditional medicine.



Fig no.1 Tridax Procubens Plant

Table No.1- Tridax Procubens plant profile

Sr.no	Attribute	Description
1	Scientific name	Tridax Procumbens
2	Family	Asteraceae
3	Common names	Coat buttons, Tridax Daisy, Ghamra
4	Plant type	Creeping perennial herb
5	Origin	Native to tropical America
6	Distribution	Asia, Africa, Australia and tropical regions
7	Habitat	Roadside wasteland garden, open fields
8	Stem	Slender, hairy branches widely, roots at nodes
9	Leaves	Opposite, Ovate to lanceolate, toothed margins

2. Excipient Profile

1. Carbopol 934

Pharmacopoeial Name: Carbomer 934 (as per USP/NF, BP)

Synonyms: Polyacrylic acid, Carboxypolymethylene, Carbomer

Empirical Formula: $(C_3H_4O_2)_n$ (Carbopol 934 is a cross-linked polyacrylic acid polymer)

Molecular Weight: High molecular weight polymer, typically ranging from 700,000 to 3,000,000 g/mol High molecular weight polymer, typically ranging from 700,000 to 3,000,000 g/mol

Category: Gelling agent, Thickening agent, Suspending agent, Bioadhesive polymer, Controlled-release agent

2. Methyl paraben

Pharmacopoeial Name: Methyl paraben (as per USP/NF, BP, EP)

Synonyms: Methyl p-hydroxybenzoate, Methyl 4-hydroxybenzoate, Nipagin M

Empirical Formula: C_8H_8

Molecular Weight: 152.15 g/mol

Category: Preservative, Antimicrobial agent, Antifungal agent

3. Triethanolamine (TEA)

Pharmacopoeial Name: Triethanolamine (as per USP/NF, BP, EP)

Synonyms: Trolamine, 2,2',2''-Nitrilotriethanol, TEA $C_6H_{15}NO$

Molecular Weight: 149.19 g/mol

Category: pH adjuster, Emulsifying agent, Surfactant, Neutralizing agent

4. Propylene Glycol

Non-proprietary Name: Propylene Glycol

Synonyms: 1,2-Propanediol, Methyl Ethyl Glycol, Trimethyl Glycol

Empirical Formula: $C_3H_8O_2$

Molecular Weight: 76.09 g/mol

Category: Solvent, Humectant, Penetration enhancer

5. Ethanol

Pharmacopoeia Name: Ethanol (as per USP/NF, BP, EP)

Synonyms: Ethyl Alcohol, Alcohol, Ethanol (96%), Ethanol (Absolute), Ethanol (Denatured)

Empirical Formula: C_2H_5OH

Molecular Weight: 46.07 g/mol

6. Glycerin (Glycerol)

Pharmacopoeial Name: Glycerin (as per USP/NF, BP, EP)

Synonyms: Glycerol, 1,2,3-Propanetriol, Propanetriol

Empirical Formula: $C_3H_8O_3$

Molecular Weight: 92.09 g/mol

METHOD AND EVALUATION

❖ METHOD

1. Collection of Plant Material:

extraction purposes, healthy and mature plants were collected from clean, natural surroundings during the flowering season. The whole plant was uprooted carefully and washed thoroughly under running water to remove dirt, soil, and other impurities. After cleaning, the plant material was allowed to dry in the shade for about a week to retain its phytochemical integrity. Once dried, the



material was crushed and ground into a fine powder using a mechanical grinder. The powdered plant was then stored in an airtight container for further extraction and formulation processes.

2. Drying and Powdering:

The cleaned leaves were shade-dried at room temperature for 7–10 days to retain phytoconstituents. The dried leaves were then ground into a coarse powder using a mechanical grinder and stored in an airtight container for further use.

3. Filtration

Powdered leaves (100 g) were subjected to cold maceration using 70% ethanol for 72 hours at room temperature with occasional stirring. The extract was filtered using Whatman filter paper. The filtrate was concentrated under reduced pressure using a rotary evaporator at 40–50°C to obtain a semisolid mass. The extract was stored in a refrigerator at 4°C for further use.

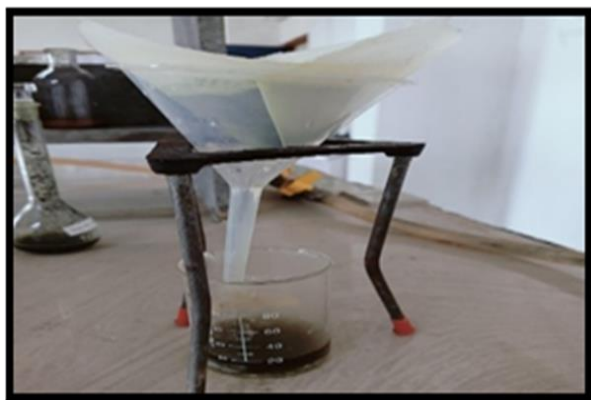


Fig no 1: extraction of Tridax Procubens

4. Preparation of Gel Base

Carbopol 940 (1–2% w/w) was slowly dispersed in 30 mL of distilled water and allowed to hydrate for 2 hours with occasional stirring.

To the hydrated Carbopol, glycerin (2–5% w/w) was added as a humectant.

The mixture was stirred gently to avoid the entrapment of air bubbles.

5. Incorporation of Extract:

The ethanol extract of *Tridax procumbens* was dissolved in a small volume of distilled water or ethanol (depending on solubility). The solution was gradually added to the hydrated gel base with continuous gentle stirring to obtain a uniform mixture.

6. pH Adjustment:

The pH of the formulation was adjusted to 6.8–7.0 using Triethanolamine, added drop wise with gentle stirring until a clear gel was formed.

7. Addition of Preservative

A solution of methyl paraben (0.15%) in warm water was added to the formulation to improve microbial stability.

8. Final Preparation:

The final volume was adjusted with distilled water, and the formulation was mixed thoroughly to form a homogenous gel. The gel was packed in sterilized, labelled containers and stored at room temperature for evaluation.

❖ EVALUATION PARAMETERS

1. pH Determination

The pH of the formulated gel was found to be in the range of 6.5 to 7.0, which is suitable for topical application and is compatible with skin pH, minimizing the risk of irritation.

2. Viscosity

Viscosity was evaluated using a Brookfield viscometer. The gel showed a moderate to high viscosity, indicating good consistency and stability. A gel with proper viscosity ensures adequate adherence to the skin and controlled drug release.

3. Spreadability

The gel exhibited excellent spreadability, which is crucial for patient compliance. The measured spreadability ranged between 15–25 g·cm/sec, depending on the formulation. Good spreadability allows even distribution on the skin surface with minimal effort.

4. Antimicrobial Testing

The antimicrobial activity of Tridax procumbens extract was evaluated using the agar well diffusion method against selected microbial strains, including *Staphylococcus aureus*, *Escherichia coli*. The results demonstrated that both the ethanolic extract and the gel formulation of Tridax procumbens exhibited significant zones of inhibition, indicating effective antimicrobial properties. Among the tested organisms, *Staphylococcus aureus* showed the highest sensitivity to the extract, followed by *E. coli*. The observed antimicrobial effect is attributed to the presence of phytochemicals such as flavonoids, alkaloids, tannins, and saponins, which are known to disrupt microbial membranes and interfere with cellular metabolism. These findings support the traditional use of Tridax procumbens in wound healing and skin infection treatments and validate its potential in formulating topical herbal gels with antimicrobial action.

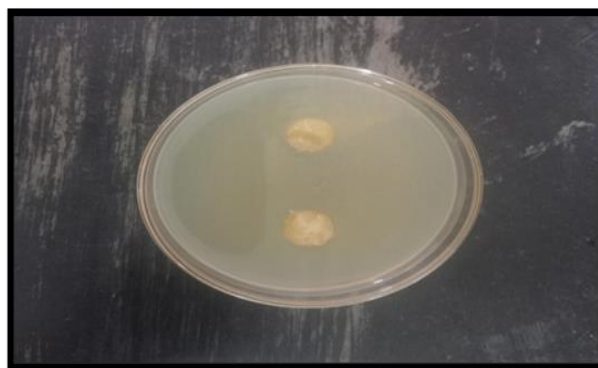


Fig No: 2 Zone of inhibition

5. Skin Irritation Test

A small amount of the prepared Tridax procumbens gel was applied to a clean area on the inner forearm of a volunteer. The area was observed for 24 hours for any signs of redness, itching, swelling, or irritation. No adverse reactions were noted, indicating the gel is safe for human skin use in topical application.



Fig No .3 Skin irritation

RESULT AND DISCUSSION

1. Evaluations of Tridax Procumbens

Table No: 2 Physical parameters

Parameter	observation
pH	6.8
Viscosity	4200cPs
Spreadability	18.2 g.cm/sec
Extrudability	good
Drug contain	98.4%
Skin irritation	No irritation

2. Phytochemical Investigation of *Tridax procumbens*

Tridax procumbens extract revealed the presence of important bioactive compounds such as

flavonoids, alkaloids, tannins, saponins, terpenoids, and glycosides, which contribute to its antimicrobial and wound healing properties

Table No : 3 Phytochemical investigation of the *tridax procumbens*

Constituents	Test	End point	Result
Alkaloids	Dragendroff reagent	red precipitate	++
Flavonoids	Ferric chloride	Green color	++
Tannins	Gelatin test	White precipitate	++
Saponins	Foam test	Stable froth	++
Proteins	Biuret test	Violet color	+
Amino acids	Nilhybrin	Purple color	++
Phenols	Ferric chloride	Deep blue	++
Organic acids	Phosphoric acid test	Precipitate	+

3. Optimization of gelling agent

The formulation of a 30-gram herbal gel using *Tridax procumbens* extract, various gelling agents were tested to achieve optimal consistency, spreadability, and stability. Carbopol 934 was selected as the most suitable gelling agent after comparing it with 0.9 g of Carbopol 934 was used to prepare 30 g of gel. The Carbopol was dispersed in distilled water and allowed to hydrate completely before neutralization with triethanolamine (TEA) to form a clear, smooth gel base. The resulting gel exhibited ideal viscosity, good spreadability, and a pH of 6.8, which is compatible with skin. It also showed no signs of phase separation, making it suitable for stable topical application. The gelling agent concentration was optimized to provide ease of

application while retaining the therapeutic efficacy of *Tridax procumbens*



Fig No :4 Formation &Evaluation of gel

4. Physical appearance

The formulated gel was visually evaluated for color, appearance, and homogeneity. The results are shown below:

Table No :4 physical appearance of gel

Parameters	F1	F2	F3
Physical appearance	Greenish-brown	Greenish-brown	Greenish-brown
Color	Pale green	Light green	Brownish -green
Homogeneity	Absence of aggregates	Slightly aggregates	Absence of aggregates

5. Measurement of pH

The pH of the gel formulations was measured at room temperature (25°C) and found to be within the acceptable dermal range. Results are given

Table No :5 Measurement of pH

Formulation of code	pH
F1	5.9
F2	5.7
F3	5.8

6. Determination of viscosity

Viscosity is a critical rheological property that defines a gel's resistance to flow and its internal friction. It directly influences the consistency, spreadability, and drug release profile of the topical formulation. In this study, the viscosity of the polyherbal gel containing different concentrations of *tridaxprocubens* extract was measured using a Brookfield viscometer (spindle no. 62) at room temperature. The measurement was conducted at a constant speed, and the results were recorded in centipoise (cps). A higher viscosity indicates better gel stability and controlled drug diffusion. The viscosity values obtained for the formulations are presented in table no .

Table No :6 Measurement of Viscosity

Formulation code	Viscosity cps
F1	1820cps
F2	1880cps
F3	1910cps

7. Spreadability

Spreadability denotes the extent of area to which the gel readily spreads on application to skin or the affected part. The spreading was expressed in terms of time in seconds taken by two slides to slip off from the gel, placed in between the slides, under certain load. Lesser the time taken for separation of the two slides, better the

spreadability. Two sets of glass slides of standard dimensions were taken. The gel formulation was placed over one of the slides. Spreadability of different gel formulations were studied. The formulation [e.g., E2] produced good spreadability than the other formulations. The results were shown

Table No.7 Measurement of Spreadability

Formulation code	Spreadability
F1	19.45
F2	20.12
F3	21.78

8. Antimicrobial activity cup plate method

The antimicrobial activity of *tridaxprocubens* extract was evaluated using the cup plate method. Nutrient agar (for bacteria) and Sabouraud dextrose agar (for fungi) were prepared and poured into sterile Petri dishes. After solidification, microbial cultures were evenly spread over the surface using sterile swabs. Wells (cups) of uniform diameter were then made in the agar using a sterile borer, and each well was filled with a measured volume of the *tridaxprocubens* extract. Standard antibiotics served as positive controls, while solvents used for extraction acted as negative controls. The plates were incubated at 37°C for 24 hours for bacterial strains and at 28°C for 48–72 hours for fungal strains. The zones of inhibition around the wells were measured in millimeters, indicating the antimicrobial efficacy of the extract. The result. Demonstrated the potential antimicrobial properties of the *tridaxprocubens* extract, with variation in effectiveness depending on the microorganism tested.

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