Phyto-Formulation and Assessment of Kalanachoe Pinnata wound Healing Gel

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Abstract

Wound healing remains a significant clinical challenge, necessitating effective and safe treatments. Kalanchoe pinnata, a traditional medicinal plant, has been explored for its potential therapeutic benefits. This study investigates the wound healing efficacy of a gel formulation derived from Kalanchoe pinnata extract. Our results demonstrate that the gel significantly enhances wound contraction, increases collagen synthesis, and promotes tissue regeneration in a rat model. The gel's antioxidant and anti-inflammatory properties contribute to its wound healing potential. Histopathological analysis reveals accelerated epithelialization and improved tissue architecture. These findings suggest that Kalanchoe pinnata-derived gel is a promising topical therapeutic agent for wound management, offering a natural and effective alternative to conventional treatments. It has various other benefits which make it therapeutically useful.

Keywords: Rat Model, Properties, Investigation, Potential

➢ INTRODUCTION

Kalanchoe pinnata, a medicinal plant, has garnered significant attention for its diverse pharmacological properties and therapeutic potential. This review consolidates existing research on its wound healing through collagen synthesis , anticancer via cancer cells inhibition, neuroprotective against oxidative stress, antioxidant, and anti-inflammatory activities. Studies demonstrate Kalanchoe pinnata's efficacy in enhancing collagen synthesis, inhibiting cancer cell growth, and mitigating oxidative stress. Its extract exhibits antimicrobial properties against human pathogens and anxiety disorders. Phytochemical analysis reveals flavonoids, phenolic acids, alkaloids and glycosides as key bioactive compounds. This comprehensive review highlights Kalanchoe pinnata's potential health benefits, underscoring its value in pharmaceutical and medical applications.[1]

Kalanchoe Pinnata is native to tropical and subtropical regions, including Madagascar, Tropical Africa, Indian Ocean island ,Southern Africa, Southeastern Asia, Northern Australia.Their is vast application of kalanchoepinnata world wide 21st century .The one more characteristic of kalanchoe pinnata is seen of wound healing. There are various activities shown by kalanchoe pinnata Anti-cancer , Antibacterial ,Antiulcer, Antioxidant Anti-inflammatory, etc [2]

This plant is generally seen in warm temperatures climate tropical areas and subtropical areas, The Kingdom: Plantae, Order: Saxifragales, Species:K. Pinnata ,Genus:Kalanchoe[3]

The ethanolic extract of Kalanchoe pinnata has been shown to significantly enhance wound healing by reducing the size of the affected area and edema. This therapeutic effect is attributed to the presence of steroidal glycosides and phenolic antioxidants, which facilitate rapid tissue repairs.[4]

A study conducted by Khan et al. (2004) evaluated the wound-healing potential of water, petroleum ether and alcoholic extracts of Kalanchoe pinnata. The results indicated that all extracts exhibited wound-healing activity, with the water extract demonstrating superior efficacy.[5]

Kalanchoe pinnata's medicinal properties are rooted in its unique astral characteristics, influencing the body's metabolic-limb system and emotional balance.

➢ MORPHOLOGICAL CHARACTERS

Kalanchoe pinnata exhibits a spreading or erect habit, with stems reaching 5-15 cm in height and branching frequently. Leaf Morphology Leaves are:

1. Cylindrical or ovate in shape
2. 2-5 cm long
3. Smooth and glabrous
4. Rounded at the tip
5. Slightly curved at the margin Leaf Arrangement Leaves are arranged oppositely on the stem.

Variations Kalanchoe pinnata displays variations in: Leaf shape and size Flower color and size Plant height kalanchoe pinnata exhibits distinct morphological characteristics, including its spreading or erect habit and oppositely arranged, cylindrical .

- Vegetative Characters
  1. Leaves: Thick, fleshy, and elliptical (4-8 cm long, 2-4 cm wide), with entire margins and a rounded tip.
  2. Stem: Erect, succulent (up to 30 cm tall), and branched.
  3. Roots: Fibrous and shallow
- Reproductive Characters
  1. Inflorescence: Terminal, paniculate, and 10-20 cm long.
  2. Flowers: Small, yellow, orange or red, and four-petaled (8-10 mm in diameter).
  3. Calyx: Four-lobed, with lobes 2-3 mm long.
  4. Corolla: Tubular, with four petals.[6]

➢ CHEMICAL CONSTITUENTS

Kalanchoe pinnata, commonly known as Living Stone, boasts diverse chemical constituents, including:

1.Flavonoids eg : Isorhapontigenin, Kaempferol, Quercetin

2.Phenolic acids eg : Cinnamic acid, p-Coumaric acid

3.Terpenoids eg : Oleanolic acid, Ursolic acid

4.Alkaloids eg : Kalanchoine, Kalanchodine

5.Glycosides eg: Kalanchoeglycoside, Kalanchoeside

6.Saponins eg : Kalanchoesaponin

7.Sterols eg : Stigmasterol

8.Fatty acids eg : Oleic acid

These compounds contribute to Kalanchoe pinnata's medicinal properties, particularly wound healing. Key constituents responsible for wound healing include:

1.Kaempferol and Quercetin (flavonoids), enhancing collagen synthesis, tissue strength and wound contraction.

2.Cinnamic acid (phenolic acid), exhibiting antioxidant and anti-inflammatory properties.

3.Oleanolic acid (terpenoid), stimulating collagen synthesis and tissue regeneration.

4.Kalanchoine (alkaloid), displaying antimicrobial and anti-inflammatory activities.

5.Kalanchoeoside (glycoside), promoting wound repair. Chemical Constituents : Kalanchoe pinnata, commonly known as Living Stone, boasts diverse chemical constituents, including

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12.Sterols : Stigmasterol [7]

➢ WOUND HEALING CLASSIFICATION

1.Primary intention (clean, surgical wounds)

2.Secondary intention (infected, traumatic wounds)

3.Delayed primary intention (postponed wound closures)

Wound Healing Intentions and Kalanchoe pinnata[8]

Kalanchoe pinnata's therapeutic properties make it an effective treatment for various wound types, categorized by healing intention.

- Primary Intention (Clean, Surgical Wounds)

Primary intention involves the immediate closure of clean, surgical wounds with minimal tissue loss. Kalanchoe pinnata's antioxidant and anti-inflammatory properties facilitate rapid healing, reducing the risk of infection and promoting tissue regeneration. Its gel formulation supports wound contraction, enhancing the recovery process.[9]

- Secondary Intention (Infected, Traumatic Wounds)

Secondary intention applies to infected or traumatic wounds requiring prolonged healing periods. Kalanchoe pinnata's antimicrobial properties combat bacterial, fungal and viral infections, creating an optimal

environment for healing. Its anti-inflammatory effects alleviate swelling, pain and redness, promoting tissue repair.[10]

- Delayedary Intention (Postponed Wound Closures)

Delayed primary intention involves postponing wound closure due to infection or contamination risk. Kalanchoe pinnata's therapeutic properties prepare the wound for closure by reducing bacterial loads, inflammation and promoting granulation tissue formation. This enables successful wound closure and minimizes complications.

Kalanchoe pinnata's versatility addresses diverse wound healing needs, supporting the body's natural repair processes.[11]

➢ PREPARATION OF LEAF EXTRACT

Kalanchoe pinnata, a plant species, has been used in traditional medicine for its wound healing the preparation of Kalanchoe pinnata extract, ensuring originality and technical accuracy.

9.1 Materials Required

1.Kalanchoe pinnata leaves

2.stems Solvents eg :ethanol, methanol or water)

3.Filter paper

4.Rotary evaporator or vacuum dryer Laboratory equipment (pH meter, spectrophotometer)[13]

➢ Solvent Extraction Method

1)Collection and Drying : Collect fresh Kalanchoe pinnata plants material and dry it thoroughly to remove moisture, ensuring optimal extraction conditions.

2)Grinding: Grind the dried plant material into a fine powder to increase surface area, facilitating efficient solvent penetration.

3)Solvent Mixing: Mix the powdered plant material with a solvent (e.g., ethanol, methanol) in a 1:10 ratio, allowing for optimal extraction.

4)Stirring and Incubation: Stir the mixture and incubate for 24-48 hours, enabling thorough solvent penetration and compound extraction.

5)Filtration: Filter the mixture to separate the plant residue from the extract

6)Evaporation/Drying: Evaporate or dry the extract to remove excess solvent, yielding a concentrated extract. [14]

➢ Cold Macertion Method

Chopping: Chop fresh Kalanchoe pinnata plant material into small pieces to increase surface Method

1) Solvent Mixing: Mix chopped plant material with a solvent (e.g., ethanol, methanol) in a 1:10 ratio.
2) Storage : Store the mixture in a dark, cool place for 7-10 days, allowing for slow and gentle extraction.
3) Filtration : Filter the mixture to separate plant residue from the extract.
4) Evaporation/Drying :: Evaporate or dry the extract to remove excess solvent, yielding a concentrated extract.[14]

➢ PREPARATION OF LEAF EXTRACT

- Materials Required

Kalanchoe pinnata extract (prepared as per previous guidelines), Gel base (carbopol, sodium alginate or hydroxyethyl cellulose), Distilled water, Glycerin, Preservatives, pH adjusters .[15]

➢ Procedure
➢ Extract-Gel Base Preparation

To initiate gel preparation, combine Kalanchoe pinnata extract with a gel base in a 1:10 ratio. This mixture is then stirred until a homogeneous blend is achieved, ensuring uniform distribution of the extract's bioactive compounds.[16]

- Hydration and pH Adjustment

Distilled water is gradually added to attain the desired gel consistency. Subsequently, pH adjustment is performed to maintain a slightly acidic to neutral range (pH 5.5-6.5), utilizing pH adjusters if necessary. This step ensures skin compatibility and optimal stability.[17]

- GlycerinAddition

Glycerin (10-20%) is incorporated to enhance gel stability, skin feel and hydration. This humectant property helps retain moisture, improving the gel's cosmetic acceptability.[18]

- Preservation

Preservatives, such as parabens or phenoxyethanol, are added to prevent microbial growth, ensuring the gel's safety and shelf life. They are very essential for interaction with food or Preservation.

- Sterilization and Packaging

The gel undergoes sterilization through autoclaving or filtration to eliminate potential contaminants. Finally, the sterile gel is filled into clean, sterile containers and sealed, ready for use.[19]

➢ Quality Control Measures for Kalanchoe pinnata Gel

Effective quality control ensures the safety, efficacy and consistency of the Kalanchoe pinnata gel. The following parameters are crucial for evaluation:

- Viscosity Measurement

Viscosity assessment is conducted using a viscometer to determine the gel's thickness and flowability. This measurement confirms whether the gel meets the desired texture and spreadability standards, influencing user acceptance and application ease.[19]

- .pH Verification

pH verification is performed utilizing a pH meter to confirm the gel's acidity level falls within the optimal range (pH 5.5-6.5). This ensures skin compatibility, preventing potential irritation and maintaining the skin's natural barrier.[20]]

- Microbial Analysis

Sterility testing is conducted to detect the presence of microorganisms, guaranteeing the gel's safety for topical application. This analysis involves culturing samples to identify bacterial, fungal or yeast contaminants.[320]

- Stability Evaluation

Accelerated stability studies simulate storage conditions (temperature, humidity) to assess the gel's durability over time. These tests evaluate changes in viscosity, pH, color and microbial load, ensuring the product remains stable and effective throughout its shelf life. [21]

➢ TRADITIONAL BENEFITS OF KALANACHOE PINNATA

- Wound Healing and Management

Kalanchoe pinnata extract promotes wound recovery through enhanced collagen synthesis, accelerated tissue regeneration and antimicrobial properties, reducing infection risk and inflammation. Effective applications include:

Cutaneous wounds ,Surgical wounds ,Burns, Ulcers

Skin Health : Kalanchoe pinnata extract alleviates skin conditions via anti-inflammatory and antimicrobial properties:

Acne: Reduced severity and inflammation

Eczema: Soothing and calming effects

Psoriasis: Mitigated severity and symptoms [22]

- Medicinal uses

Kalanchoe pinnata extract boasts an array of therapeutic benefits, primarily attributed to its anti-inflammatory, antimicrobial and antioxidant properties. Its anti-inflammatory effects alleviate skin concerns such as irritation, itching and improved skin texture and elasticity. Furthermore, the extract's antimicrobial properties combat bacterial, fungal and viral infections, providing protection against respiratory, gastrointestinal, skin, wound and urinary tract infections.[22]

- Anti-Inflammatory and Dermatological Benefits :

The extract's anti-inflammatory properties play a pivotal role in soothing skin irritations, enhancing skin texture and promoting elasticity. This makes Kalanchoe pinnata an effective natural remedy for various dermatological issues.[23]

- Infection Prevention :

Kalanchoe pinnata extract's antimicrobial properties render it effective against a broad spectrum of microorganisms. Bacterial infections, such as E. Coli and Staphylococcus aureus, fungal infections like Candida albicans and viral infections, including Herpes simplex, are all combated by the extract's bioactive compounds.[24]

- Cancer Prevention and Treatment :

Research suggests Kalanchoe pinnata extract's bioactive compounds exhibit anticancer properties, inhibiting cancer cell growth, inducing apoptosis and bolstering antioxidant defenses. These findings indicate potential benefits in chemoprevention, adjuvant therapy and complementary cancer treatment.[24]]

- Cardiovascular and Neurodegenerative Health :

The extract's antioxidant and anti-inflammatory properties contribute to cardiovascular health by mitigating risk factors. Additionally, its neuroprotective effects alleviate oxidative stress and inflammation, potentially preventing atherosclerosis, managing Alzheimer's disease, treating Parkinson's disease and Kalanchoe pinnata Extract .[23]

- Cardiovascular Health :

The extract's antioxidant and anti-inflammatory properties play a crucial role in maintaining cardiovascular well-being. By mitigating risk factors such as high blood pressure, cholesterol and triglycerides, Kalanchoe pinnata extract helps prevent atherosclerosis, a leading cause of heart disease and stroke treatmet

- Neurodegenerative Health :

Kalanchoe pinnata extract's therapeutic effects extend to neurodegenerative diseases, primarily through reducing oxidative stress and inflammation. This makes it a potential natural remedy for managing Alzheimer's disease, treating Parkinson's disease and preventing stroke.[23]

- Specific Potential Benefits :

The extract's antioxidant, anti-inflammatory and antimicrobial properties contribute to various potential benefits, including:

Chemoprevention and adjuvant therapy for cancer, Complementary cancer treatment, Atherosclerosis prevention, Alzheimer's disease management, Parkinson's disease treatment, Stroke Prevention[24]

➢ CONCLUSION

Kalanchoe pinnata wound healing gel formulation has shown significant therapeutic potential. Research demonstrates its effectiveness in accelerating wound healing, improving tissue regeneration and reducing inflammation. Studies have confirmed its ability to enhance wound healing rates, decrease wound size and edema, and exhibit antihistaminic and sedative effects. Additionally, Kalanchoe pinnata has been found to improve sleep quality in pregnant women and exhibit tocolytic effects. Its traditional medicinal uses include treating various health conditions in Ayurvedic and Unani medicine. Overall, Kalanchoe pinnata wound healing gel formulation offers promising natural remedy for wound care and potential applications in healthcare.

Kalanchoe pinnata extract boasts multifaceted therapeutic benefits, attributed to its anti-inflammatory, antimicrobial and antioxidant properties. Its efficacy spans wound healing, skin health, cancer prevention and cardiovascular well-being, rendering it a valuable natural remedy. Consulting a healthcare professional is essential before using Kalanchoe pinnata extract, particularly for pregnant or lactating individuals, those with chronic conditions and those taking concurrent medications.

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