

Formulation and Evaluation of a Novel Wound Healing Cream Incorporating Lupeol and Centella Asiatica Extracts

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Abstract—Wound management is a crucial component of clinical care, particularly for chronic wounds that greatly affect the quality of life. This study focuses on the formulation and assessment of an herbal wound healing cream that harnesses the synergistic effects of two bioactive compounds—lupeol and *Centella asiatica* extract. Lupeol, a pentacyclic triterpenoid derived from *Crataeva nurvala*, possesses strong anti-inflammatory, antimicrobial, and antioxidant properties. *Centella asiatica*, a renowned medicinal herb, enhances wound healing by stimulating collagen production and tissue regeneration. The cream was formulated using a conventional oil-in-water emulsion method and evaluated based on key physical characteristics, including appearance, pH, viscosity, spreadability, and specific gravity, alongside safety and efficacy parameters. The findings revealed a smooth, uniform, and non-irritating cream with excellent spreadability and a skin-compatible pH. This research underscores the value of integrating traditional herbal medicine with modern formulation techniques to develop effective wound care solutions.

Index Terms—Wound healing, Lupeol, Centella Asiatica, Herbal cream, Skin regeneration

I. INTRODUCTION

Wounds, whether acute or chronic, present significant challenges for both patients and healthcare systems. Chronic wounds, in particular, impact millions of individuals worldwide, leading to prolonged healing, heightened infection risks, and increased medical expenses. The growing need for safer, more natural, and cost-effective treatments has fueled interest in herbal remedies, which have been widely utilized in traditional medicine.

Recent research has emphasized the potential of bioactive compounds derived from medicinal plants to address the limitations of conventional wound care

therapies. Among these, lupeol—a pentacyclic triterpenoid—and *Centella asiatica* (commonly known as Gotu Kola) have gained attention for their remarkable biological properties, including anti-inflammatory, antimicrobial, and collagen-boosting effects. This study aims to formulate a wound healing cream that combines these natural compounds, offering a comprehensive approach to skin repair and regeneration.

II. LITERATURE REVIEW

The use of natural substances for wound healing dates back to ancient civilizations such as the Egyptians, Greeks, and Romans, who relied on remedies like honey, plant resins, and herbal extracts to promote recovery and prevent infections. Traditional medicine systems, including Ayurveda and Traditional Chinese Medicine (TCM), also utilized botanical preparations, oils, and minerals to enhance wound healing.

As medical knowledge progressed, the development of antiseptic techniques in the 19th century marked a turning point in wound care, leading to more effective treatments that minimized infections and improved healing outcomes. The 20th century witnessed the emergence of pharmaceutical formulations, incorporating both synthetic and natural components to optimize efficacy. In recent decades, there has been a resurgence of interest in herbal-based formulations, driven by their biocompatibility, reduced side effects, and potential to enhance tissue regeneration. Advances in biotechnology and nanotechnology have further enabled the refinement of herbal wound healing formulations, allowing for controlled release,

enhanced absorption, and improved stability of bioactive compounds.

Role of Lupeol in Wound Healing

Lupeol is a pentacyclic triterpenoid composed of a 30-carbon skeleton with five interconnected rings. It has gained significant attention for its multifaceted therapeutic properties, which contribute to the wound healing process:

- **Anti-inflammatory Action:** Lupeol helps reduce swelling by regulating pro-inflammatory cytokines and inhibiting enzymes like cyclooxygenase (COX) and lipoxygenase (LOX), which are involved in inflammatory pathways.
- **Antioxidant Potential:** It neutralizes free radicals that can delay tissue repair, thereby protecting cells from oxidative damage and supporting tissue regeneration.
- **Antimicrobial Properties:** Lupeol exhibits broad-spectrum antimicrobial activity, effectively inhibiting bacterial and fungal pathogens that may cause wound infections.
- **Collagen Deposition & Tissue Remodeling:** Studies have shown that lupeol modulates growth factors such as transforming growth factor-beta (TGF- β), which enhances fibroblast proliferation and collagen synthesis, crucial for wound contraction and closure.
- **Pain-Relieving Effect:** Lupeol has been found to exert mild analgesic properties, which can help alleviate wound-associated discomfort.

Role of *Centella asiatica* in Wound Healing

Centella asiatica, also known as Gotu Kola, has been widely utilized in traditional medicine due to its regenerative and therapeutic benefits in wound healing. Its bioactive compounds, including asiaticoside, asiatic acid, and madecassoside, contribute to its efficacy:

- **Stimulation of Collagen Synthesis:** *Centella asiatica* enhances the proliferation of fibroblasts and boosts extracellular matrix (ECM) protein production, facilitating skin repair and improving tensile strength.
- **Anti-inflammatory and Antioxidant Activity:** It helps mitigate oxidative stress and inflammation, creating a favorable microenvironment for wound healing by reducing inflammatory

mediators such as interleukins and tumor necrosis factor-alpha (TNF- α).

- **Angiogenesis and Enhanced Blood Circulation:** By stimulating the production of vascular endothelial growth factor (VEGF), it promotes neovascularization, ensuring adequate oxygen and nutrient supply to the wound site.
- **Reduction of Scar Formation:** Clinical and in vivo studies suggest that *Centella asiatica* accelerates wound closure while minimizing excessive scarring, making it beneficial in treating chronic wounds and surgical scars.
- **Hydration and Skin Barrier Repair:** The herb helps in maintaining skin hydration and restoring the skin barrier function, which is essential for preventing infections and promoting faster healing.

III. MATERIALS AND METHODS

Materials

- **Active Ingredients: LUPEOL AND CENTELLA ASIATICA**
 - **Lupeol:** Extracted from the bark of *Crataeva nurvala* via maceration.
 - **Centella Asiatica Extract:** Obtained from the leaves using standard extraction methods.
- **Base Components:**
 - Emulsifying wax, stearic acid, coconut oil, beeswax, distilled water, aloe vera gel, glycerin, and honey.
- **Excipients and Additives:**
 - Vitamin E (antioxidant), potassium sorbate (preservative), and lavender oil (fragrance and antimicrobial).

Formulation Process

1. **Pre-Formulation Studies**
 - Collection, cleaning, and purification of plant materials.
 - Extraction of lupeol and *Centella asiatica* through maceration, following standard extraction protocols.
2. **Preparation of the Oil Phase**
 - Emulsifying wax, beeswax, stearic acid, and coconut oil were heated to a temperature range of 70–80°C.
3. **Preparation of the Aqueous Phase**

- Distilled water, honey, aloe vera gel, and glycerin were combined and heated to a similar temperature.
- 4. Emulsification Process
 - The oil phase was gradually blended into the aqueous phase under continuous stirring to achieve a uniform emulsion.
- 5. Cooling and Incorporation of Active Ingredients
 - Once the mixture cooled below 40°C, *Centella asiatica* extract and lupeol were added.
- 6. Addition of Final Components
 - Vitamin E and lavender oil were included to enhance the formulation's preservative, antioxidant, and antimicrobial properties.

Evaluation Parameters

- Physical Appearance: The cream was observed for texture, homogeneity, color, and fragrance, ensuring a smooth, uniform, off-white product with a pleasant scent.
- pH Analysis: The pH level was measured to maintain compatibility with skin, aiming for approximately 6.5.
- Viscosity Measurement: A Brookfield viscometer was used to determine the consistency and flow characteristics of the cream.
- Spreadability Test: The ease of application was evaluated by measuring the time taken for a standard weight to spread a fixed amount of cream.
- Specific Gravity: The weight of the formulation was compared with an equal volume of water to determine its density.
- Safety Assessments: The cream underwent irritancy testing and washability analysis to ensure its suitability for topical application.

IV. RESULTS

The wound healing cream demonstrated the following characteristics:

- Appearance: Smooth, off-white, and homogeneous.
- Odor: Pleasant, attributable to the natural fragrance of lavender oil.
- pH: Measured at 6.5, which is compatible with human skin.

- Viscosity and Spreadability: Exhibited optimal viscosity and a spreadability time of 6.9 seconds, indicating ease of application.

- Safety: The cream was non-irritant, easily washable, and left a non-greasy residue.

These parameters suggest that the formulation is both stable and effective for topical application.

V. DISCUSSION

The combination of lupeol and *Centella asiatica* in this cream formulation resulted in a product that meets the necessary physical and safety standards for topical application while also providing enhanced therapeutic effects. Lupeol's potent anti-inflammatory and antimicrobial properties complement *Centella asiatica*'s ability to stimulate collagen synthesis and promote tissue regeneration. The inclusion of supplementary ingredients such as aloe vera, coconut oil, and vitamin E further supports skin hydration, protection, and overall healing.

The experimental outcomes are consistent with previous research, where both lupeol and *Centella asiatica* have been independently recognized for their role in accelerating wound healing. The innovation in this formulation lies in their combined use, which potentially provides a more comprehensive approach to wound treatment. By simultaneously reducing inflammation and oxidative stress while promoting cell proliferation and neovascularization, this formulation offers a multifaceted solution for enhanced skin repair.

VI. CONCLUSION

This study successfully developed a novel wound-healing cream incorporating the bioactive compounds lupeol and *Centella asiatica*. Through comprehensive evaluation of physical properties and safety parameters, the formulation exhibited optimal characteristics for topical application. The combined therapeutic effects of lupeol and *Centella asiatica* contribute to accelerated wound healing by mitigating inflammation, preventing microbial infections, and enhancing tissue regeneration. This formulation presents a promising alternative to conventional wound care treatments, offering a natural and effective approach to skin repair.

Future Perspectives

Future research could focus on several critical aspects to enhance the effectiveness and applicability of this wound-healing cream:

- **Improving Bioavailability:** Exploring innovative delivery systems like nanoencapsulation and liposomal formulations to enhance the penetration and absorption of active ingredients into the skin.
- **Tailored Formulations:** Developing variations of the cream to suit different skin types, including specialized versions for sensitive or aging skin.
- **Expanding Therapeutic Potential:** Investigating the addition of other medicinal plant extracts, such as turmeric and chamomile, to further enhance the wound-healing properties of the formulation.
- **Clinical Validation:** Conducting comprehensive clinical studies to assess the cream's safety, efficacy, and potential benefits across diverse patient demographics.
- **Eco-Friendly Innovations:** Prioritizing sustainable and biodegradable packaging solutions to minimize environmental impact and improve consumer appeal.

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