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MECHANISM-BASED EVALUATION OF MEDICINAL PLANTS IN THE MANAGEMENT OF VENOUS LEG ULCERS: A COMPARATIVE REVIEW

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ABSTRACT

Venous leg ulcers (VLUs) are chronic, slow-healing wounds primarily caused by chronic venous insufficiency, venous hypertension, inflammation, oxidative stress, impaired angiogenesis, and defective collagen remodelling. They represent a significant clinical burden due to prolonged healing time, high recurrence rates, and negative impact on patient quality of life. Conventional management strategies such as compression therapy, wound dressings, and antimicrobial treatment are effective but often require long treatment durations and may not adequately address the underlying pathological mechanisms. In recent years, medicinal plants have gained attention as complementary therapies because of their multi-targeted actions, cost-effectiveness, and favourable safety profiles. This review focuses on the therapeutic potential of three medicinal plants—*Centella asiatica*, *Hibiscus rosa-sinensis*, and *Mimosa tenuiflora*—in the management of venous leg ulcers. These plants exhibit diverse pharmacological activities, including anti-inflammatory, antioxidant, angiogenic, collagen-stimulating, and antimicrobial effects, which directly counteract the key pathophysiological processes involved in VLUs. Among them, *Centella asiatica* demonstrates the most comprehensive wound-healing profile, supported by experimental and clinical evidence showing enhanced collagen synthesis, improved microcirculation, angiogenesis, and reduced

inflammation. *Hibiscus rosa-sinensis* primarily contributes anti-inflammatory and antioxidant support, while *Mimosa tenuiflora* is particularly beneficial for infected and biofilm-associated ulcers due to its strong antimicrobial activity. Overall, medicinal plants represent promising adjuncts to conventional therapy for venous leg ulcers. However, further well-designed clinical trials, standardised formulations, and long-term safety evaluations are necessary to establish their definitive role in clinical practice.

KEYWORDS: *Venous leg ulcers; chronic venous insufficiency; medicinal plants; wound healing; Centella asiatica.*

1. INTRODUCTION

Venous leg ulcers (VLUs) are chronic wounds, such as skin defects. Venous leg ulcers (VLUs) are among the most common ulcers of the lower extremities. Venous leg ulcers are a global problem in various countries. VLU accounts for 70 to 80 % of people affected.[1] In this, problems are associated with blood circulation, such as chronic venous ulcers. The disease is associated with the complication of chronic insufficiency of the vein. The malfunction of the veins' valves affects the oxygen and nutrient supply to the tissues. Normally, individual people between 60 and 80 years old are usually affected.[2] Venous leg ulcers, also known as venous stasis ulcers, are leg wounds that occur when the leg veins do not circulate blood back towards the heart. Other common names include gravitational ulcer, varicose ulcer, venous stasis ulcer and venous insufficiency ulcer. They are caused by improper blood flow or venous circulation in the legs. It is also called a type of vascular ulcer. Venous ulcers occur normally on the side of the lower limb above the ankle and below the calf. The healing of venous ulcers takes a long time (slow to heal). They lead to other conditions in the leg. VLUs are defined as full-thickness skin loss located between the knee and ankle. At the time, this condition could still be treated in many different ways using different compounds (various topical and surgical treatments were available).[3]

2. Pathophysiology of VLUs

Venous leg ulcer is one such common and largely neglected chronic dermatological condition. The normal blood flow is from the superficial veins to the deep veins and from the legs to the heart. Both have a single-way venous valve. The inability of the systems happens when there is a complication of the blood flow, and as a result, it creates a pathway for the blood flow, puts the blood together, and it turns into venous hypertension. The venous

hypertension happens by the expansion and exaggeration of the vein. This condition of veins creates venous insufficiency that leads to the damaged or weakened valves.[4]

Both the macro and micro venous systems of the venous system are affected. In the macro-venous component, there are irregularities such as venous valve dysfunction and obstruction leading to venous hypertension due to the common pathway.[1]

Several predisposing factors develop venous hypertension, such as advanced age, genetic predisposition, family history, pregnancy, oestrogen levels, obesity, prolonged standing and sitting.[1] This venous hypertension leads to capillary leakage. This will cause tissue damage, inflammation, and poor oxygen access. This will cause the destruction of the skin and the underlying tissues, leading to the development of ulcers.[5] The levels of degradation of type III collagen and collagen turnover were higher in ulcers that healed compared to ulcers that did not heal.[6]

1. Venous hypertension:
Non-functional valves or blocked deep veins prevent the return of the blood, and the blood accumulates under pressure in the veins of the lower legs (venous hypertension). They result from damaged or weakened valves.

2. Inflammation
3. Impaired angiogenesis & fibroblast dysfunction
Hypoxia and inflammation mediators inhibit the signalling of angiogenesis (VEGF and PDGF). This results in a lack of capillary growth, fibroblast in chronic wounds display a senescent phenotype. They produce insufficient ECM.

4. Tissue damage

5. Ulceration (chronic wound)

STEPS OF PATHOPHYSIOLOGY

Faulty veins

High pressure

Inflammation and cell leakage

⬇

Tissue damage and fibrosis

⬇

Skin breakdown (ulcer)

Figure 1: picture of the pathophysiology of VLUs.

3. Symptoms

The patient has several disabling symptoms, including[7]

- Pain
- Anxiety
- Depression
- Insomnia
- Itching & tingling
- Leg swelling
- Skin changes like redness, brown staining
- Thin skin
- Sore with a red base sometimes covered by yellow tissue
- Skin discolouration
- Heaviness
- Enlarged vein.

4. Why healing is difficult

One reason why venous leg ulcers (VLUs) are so difficult to treat is that the malfunctioning veins generate a high-pressure environment that leads to swelling, inflammation, ineffective oxygen and nutrient delivery, tissue damage and fluid leakage that prevent the natural wound healing cycle. About 70% of venous ulcers will heal within a 24-week period (6 months). The other 30% that remain unhealed may often be despite evidence-based practice.[8] VLUs are considered chronic wounds, and most of these happen because of healing complications caused by CVI. In either case, healing is complex due to a variety of factors that interfere with the natural wound-healing process.

4.1 Factors for difficult healing

a) Patient-related: Older age, obesity, diabetes, malnutrition, smoking, and high blood pressure.
b) Ulcer-related: Large wound size, long duration, severe infection, or presence of arterial disease (PAD).
c) Venous system: History of deep vein thrombosis (DVT), severe venous reflux (backward flow) or blockage.
d) Treatment-related: Non-compliance with compression therapy (key treatment) or incorrect wound management.

4.2 Persistent VLUs often fail to heal due to

1) Chronic inflammation

The high level of pro-inflammatory cytokines (TNF-α, IL-1β, IL-6) prevents the development into the proliferative stages of wound healing.

2) Impaired microcirculation: Venous reflex and hypertension lead to stasis, hypoxia and endothelial dysfunction.

3) Oxidative stress: Excess reactive oxygen species (ROS) cause tissue damage and degrade growth factors.

4) Protease imbalance: Elevated matrix metalloproteinases (MMPs) degrade ECM, hindering granulation tissue formation.

5) Biofilm formation: Chronic bacterial biofilms resist host defence and antimicrobials, perpetuating inflammation.

5. Why are medicinal herbs needed

They play an important role in maintaining health, preventing disease, and developing drugs. Medicinal herbs provide active chemical compounds that help in treating disease. Adverse effects are less common in systems such as Ayurveda, Unani, Siddha, and traditional Chinese medicine grately depend on medicinal herbs. There are natural, effective, economically valuable, culturally important, and scientifically valuable sources of medication.

Conventional treatment (compression therapy, dressing, antibiotics if required) is successful but takes months to heal, and recurrence is common. Herbal medicine might be of some help in improving the healing process and reducing complications. Herbal medicines generally have fewer systemic side effects. Suitable for long use. Cost-effective and accessible, especially in developing regions.

Herbal medicines have fewer side effects compared to synthetic drugs.
Several medicinal plants are used for venous leg ulcers, such as

- Calendula officinalis (marigold)
- Arnica Montana
- Mimosa (mimosa tenuiflora)
- Centella asiatica (Gotu kola)
- Achillea millefolium (yarrow)
- Aloe Vera
- Turmeric (Curcuma longa)
- Hibiscus rosa-sinensis.

Herbal medicines offer multi-targeted mechanisms: antioxidative, immune-modulatory, angiogenic, and collagen-promoting effects, often with fewer adverse reactions. Ethnobotanical records support wound-healing use of Hibiscus rosa-sinensis, Centella asiatica, and Mimosa species.

HIBISCUS ROSA-SINENSIS

Hibiscus rosa-sinensis (H. rosa-sinensis) has been largely used in traditional medicine. They are used to cure a number of ailments as well as enhance wound healing. It is known as Chinese hibiscus, China rose, and shoe flower, and it is widely cultivated as an ornamental crop in the tropical and subtropical areas of East Asia.[10]

SYNONYMS

Hibiscus arnottii Griff. ex Mast

Hibiscus boryanus DC

Hibiscus cooperi auct

Hibiscus festalis salisb

Hibiscus liliiflorus Griff. ex Mast

Hibiscus rosiflorus Stokes

Hibiscus storckii seems[11]

Family: Malvaceae

The hibiscus herb is used in Ayurvedic medicinal science for the cure of swollen, injured tissue, wound healing, colds, and to regenerate integument.[12]

The scientific name for common hibiscus is Hibiscus rosa-sinensis L.

Taxonomic classification

Kingdom - Plantae

Subkingdom - Tracheobionta

Division - Megnoliophyta

Class - Magnoliopsida

Subclass - Dilleniidae

Order - Malvaceae

Genus - Hibiscus

Species - Hibiscus rosa sinensis

Chemical constituents

Flowers:	Leaves
Ascorbic acid	Alkaloids
Thiamine	Reducing sugars
Citric acid	Fatty acids
Glucose	Fatty alcohol
Fructose	Glycosides
Oxalic acid	Resins
Riboflavin	Hydrocarbons.[13]

Plant habit

Type: evergreen, ornamental shrub or small tree

Height: reaches an average height of 1.5 to 3 metres (5-10 ft) tall

Stem: erect, branched, smooth, with light-grey bark.

Macroscopic character

Leaves:

Colour: lobed, glossy, dark green

Shape: oval

Length: up to 8 inches

Width: 4-6 inches

Flower:

Colour: red colour

Petals: 5 (five), slightly united at the base, forming a corolla tube

Size: 5-5.5 cm.[13]

Microscopic character

Leaves

- The transverse section of the leaf is biconvex.
- Epidermis: the epidermis has a cuticle layer and consists of glandular and non-glandular trachoma.
- Palisade parenchyma: one layer of elongated cells below the upper epidermis, sometimes discontinuous in the midrib.
- Large central collateral vascular bundle.
- Xylem and phloem are present.
- Cluster crystals of calcium oxalate and mucilage cells are scattered throughout the cortical tissue.
- Secretory glands and mucilage cells are present
- Stomata: anisocytic type
- The endodermis contains different starch granules.

Flowers:

A pedicel:

- The transverse section passing through the pedicel is rounded, showing an outer epidermis of hair, then the cortex developed from 12 rows of hypodermal chlorenchymatous cells, 1-2 rows of collenchymatous cells and 3-4 rows of parenchymatous cells.
- Collateral vascular bundle enclosing wide parenchymatous cells.
- Calcium oxalate crystals are present.
- Secretory glands and mucilage cells are present in parenchymatous cells.

The petal:

- The transverse section passing through the petal shows an inner and outer epidermis enclosing homogenous mesophyll.

Cortex:

- It consists of rounded, thin-walled parenchymatous cells.

Xylem and phloem are present.[14]

PHYTOCHEMISTRY

The flowers, stems, roots, and leaves of Hibiscus rosa-sinensis contain various phytoconstituents like saponins, flavonoids, phlorotannins, terpenoids, and glycosides, as well as riboflavin, thiamine, niacin, phytosterols, tannins, and phenolic compounds.[12]

Fig. 2: picture of Hibiscus rosa sinensis.

Venous leg ulcers & wound healing

Hibiscus rosa-sinensis L. = whole plant

Part used = Flower (flower extract), management of venous leg ulcer

Reason

- ❖ Rich in flavonoids, anthocyanins, polyphenols, and triterpenoids.
- ❖ Strong anti-inflammatory, antioxidant, and angiogenic.
- ❖ Fibroblast proliferation and collagen synthesis increase.

There are different species of the plant with different flower colours. In medicinal use, the plant with red flowers is preferred. According to traditional use in traditional medicines practised in ancient times, the plant leaf and red flowers were used to treat skin furuncles and ulceration.[15]

Various parts of Hibiscus rosa sinensis, the flower extract, are the most studied for the wound- healing effect because of the highest flavonoid and anthocyanin content.

Mechanism of action

- Anti-inflammatory
- Antioxidant
- Angiogenesis
- Collagen synthesis

Anti-inflammatory**:**

Problem in VLU: TNF-α, IL-1β, and IL-6 increase, and the NF-kB pathway overactivates, also forming a chronic inflammation and healing arrest.

This flower suppresses TNF-α and IL-1β and reduces NF-KB activation.

Effect: Reduce inflammation.

Antioxidant activity

The flower extracts also consist of several antioxidants, such as flavonoids, phenolic acids, and carotenoids, which work to neutralise dangerous free radicals in a human being.

Mechanism: It works as an electron or hydrogen substitute, scavenging ROS (reactive oxygen species).

It protects against oxidative stress: Inhibition of lipid peroxidation because most of the biological damage can be attributed to the lipid peroxidation process, which inhibits certain chain reactions by the free radical mechanism.[16]

Effects: protects cells and tissues from oxidative damage.

Angiogenesis

Enhance VEGF (vascular endothelial growth factor) expression in wound tissue.

Collagen synthesis

Promotes fibroblast proliferation.

Enhance collagen synthesis at the wound site [17].

Side effects

Mild skin irritation

Rare allergic contact dermatitis

They are non-toxic in topical application, and there is less collagen and angiogenesis, so this plant is safe but less effective.

CENTELLA ASIATICA

The plant Centella asiatica (L) has been utilised as a medicinal herb for thousands of years in India, China, Sri Lanka, Nepal, and Madagascar. The plant Centella asiatica is one among the primary herbs being utilised for skin-related disorders, for wound healing, and to activate nerves and brain cells, thus being mostly known as "brain food" in India.[18] It is an herbaceous perennial plant. The genus Centella comprises about 40 species. The generic name of centella is 'ken-TEL-uh' (derived from the Greek 'centum', meaning 'hundred') and 'asiatica' is 'a-see-AT-ee-kuh'.[19]

Fig. 3: picture of Centella asiatica.

Part used: whole plant

Common name

Gotu kola, Indian pennywort, Asiatic pennywort, mandukparni.

Tamil name: Vallarai

Synonyms

Hydrocotyle asiatica L.

Hydrocotyle lunata Lam.

Centella coriacea Nannfd

Centella cordifolia

Centella dusenii Nannfd

Centella repanda (pers.) small

Centella triflora (R. et p.) Nannfd.

Centella uniflora (Col.) Nannfd.

Family: Apiaceae (or Umbelliferae)

Taxonomy classification

Kingdom - Eukaryota

Subkingdom - Embryophyta

Division - Spermatophyta

Subdivision - Angiospermae

Class - Dicotyledoneae

Subclass - Rosidae

Suporder - Aralianae

Order - Araliales (Umbelliflorae)

Family - Apiaceae or Umbelliferae

Subfamily - Hydrocotyle

Genus - Centella

Species - Centella asiatica.[20]

Phytochemical: various phytochemical compounds isolated from the plant;

1. Glycosides: Asiaticoside A & B, madecassoside and centelloside.

2. Triterpene acids: Asiatic, madecassic, terminalic, centic, centellic, centoic, betulic, brahmic and isobrahmic acid.

3. Flavonoids: 3-β-glucosyl quercetin, 3-β-glycosyl kaempferol, kaempferol and quercetin.
4. Alkaloids: the alkaloid hydrocotylin has been isolated from the dried plant.
5. Volatile oil
6. Fatty oil: Glycerides of palmitic, stearic, lignoceric, oleic and linolenic acids.
7. Vitamin B, C, G and some amino acids.[21]

Main active constituents:

- Triterpenoid saponins
- Asiaticoside
- Madecassoside
- Asiatic acid.

Macroscopic character

Colour: Green

Root: vertical root stalk

Leaves: leaves are cordate or hastate or orbicular; contain a long petiole and small stipules.

Flower: small, sessile and dark pink in colour

Odour: characteristic

Taste: Bitter-sweet taste.

Microscopic character

- Stomata: paracytic and diacytic types present on both surfaces of the leaf.
- Palisade cells are two layers thick
- Parenchymatous cells with calcium oxalate crystals
- 2-3 layers of collenchyma cells present below the epidermis
- Trichomes are also present.[22]

Pharmacological activities

- ❖ Hepatoprotective
- ❖ Anti-cancer
- ❖ Anti-bacterial
- ❖ Anti-fungal
- ❖ Anti-inflammatory
- ❖ Neuroprotective
- ❖ Antioxidant

- Wound healing
- Antidepressant
- Antidiabetic
- Cognitive function.[23]

Mechanism of action

Anti-inflammatory activity

Reduce inflammation by inhibition of inflammatory mediators (TNF-α, IL-1β, IL-6) and enzymes (Cox 2, Lox) and suppression of NF-KB activation.[24]

The active constituent of asiaticoside, therefore, possesses an anti-inflammatory property. The crude extracts contain bioactive terpene acids like Asiatic acid and madecassic acid, which could be responsible for the anti-inflammatory effect.[25]

Neuroprotection and cognitive enhancement:

Increased cerebral blood flow

Enhance neuronal survival and growth.

Inhibition of acetylcholinesterase (AchE)

Stimulation of neurotrophic factors (BDNF, NGF)

Wound healing & collagen synthesis:

Stimulation of collagen synthesis in various cell types: the asiaticoside increased the tensile strength of the newly formed skin, thus advancing the healing of the wounds.

Enhanced fibroblast proliferation

Improved wound concentration

Closure antimicrobial activity

Antioxidant (free radical scavenging):

Neutralisation of reactive oxygen species (ROS)

The plant produces a large amount of antioxidants to protect against oxidative stress and inhibit lipid peroxidation.

Cardiovascular protection:

Vasodilation and improved blood flow, and anti-hypertensive effects.[24]

Angiogenesis:

Stimulates blood vessel formation (VEGF, FGF), crucial for delivering nutrients to the healing ulcer

Enhancement of endothelial migration

Enhanced vascular integrity:

This increases the integrity of the connective tissue of the veins, reducing sclerosis and improving circulation; this is major for venous sufficiency.

Side effects

Skin irritation (mild)

Rare allergic reactions in hypersensitive individuals

Hepatotoxicity - only with prolonged oral use

Topical: Topical formulations exhibit minimal systemic absorption, and side effects are rare, mild and reversible.

"Although systemic adverse effects have been reported with oral use, topical use of Centella asiatica is thought to be safe with minimal risks."

MIMOSA TENUIFLORA

Mimosa tenuiflora (Willd) is a tree. This species of bark is used for venous leg ulcers. Once the bark is dried, powdered, and directly applied, it is an effective remedy for treating skin burns and wounds.[26] Mimosa tenuiflora (Willd.) Poiret. Is an American shrub whose bark is employed in Mexican folk medicine as a burn treatment and to prevent inflammation.[27]

Fig. 4: picture of Mimosa tenuiflora.

Common name

- Jurema preta, or black Jurema
- Tepezcohuite

Family: Fabaceae, Mimosaceae

Synonyms

Acacia hostilis Mart.

Acacia jurema Mart.

Acacia tenuiflora Willd.

Mimosa Cabrera.

Mimosa hostilis Benth.

Mimosa limana.

Taxonomical classification

Kingdom - Plantae

Botanical name - mimosa tenuiflora (willd) Poir

Family - Fabaceae

Subfamily - caesalpiniodeae

Genus - Mimosa

Species - tenuiflora

Macroscopic character: (bark)

Colour: Outer surface: Dark brown to reddish-brown

Inner surface: Light brown to yellowish

Odour: slightly characteristic

Taste: Astringent

Fracture: fibrous

Texture: Hard, fibrous

Uses: Mimosa tenuiflora, a perennial shrub/tree, is well known as the ‘skin tree’ or ‘Jurema preta’ in many regions of the globe.

The leaves, stems and flowers of the plant help to cure fever, menstrual colic, headaches, hypertension, bronchitis and coughs.

In Mexico, the stem bark of this plant helps to cure burns, lesions and inflammation of the skin.[28]

Pharmacological activities

- Wound healing
- Anti-inflammatory
- Antimicrobial

- Antioxidant
- Neuropharmacological
- Analgesic
- Hemolytic
- Anticonvulsant

Phytochemicals

Presence of various secondary metabolites;[29]

Tannins

Steroids

Terpenoids

Alkaloids

Chalcones

Flavonoids

Mechanism of action

- Antimicrobial and anti-biofilm
- Anti-inflammatory
- Collagen regeneration
- Analgesic

Antimicrobial

They are protecting the body from various microbes.

Active against: Staphylococcus aureus and Pseudomonas aeruginosa[28]

Prevents biofilm formation.

Anti-inflammatory

Inhibits leukocyte infiltration and cytokine release.

Reduce inflammation.

Collagen regeneration:

Increase fibroblast activity and tensile strength of healed tissue.

Analgesic:

Reduce nociceptive signalling in the wound.

Side effects

- Possible skin irritation
- Limited long-term human safety data
- Insufficient clinical trials in chronic venous ulcers.

"Strong antimicrobial effect but lack of safety validation for chronic use"

Three plants: a mechanism-wise comparison

1. Hibiscus rosa – sinensis

Main mechanism:

Anti-inflammatory (decreases TNF-α, IL-1β)

Antioxidant (decreases ROS)

Moderate angiogenesis (increased VEGF)

Fibroblast proliferation

Strength: Early-stage wound healing inflammation is reduced.

Shortcoming: not strong collagen maturation, low clinical trials and not strong for biofilm/infection.

Conclusion: supporting plant, but not the best for VLU.

2. Centella asiatica [MOST EFFECTIVE]

- Key phytoconstituents:

Asiaticoside

Madecassoside

Asiatic acid

- Strong mechanism:

Collagen synthesis increases.

Angiogenesis increases (increased VEGF, endothelial migration).

Anti-inflammatory

Antioxidant

- Enhance microcirculation and venous tone
- Why is it best for venous leg ulcers?
- Directly target for VLU pathophysiology
- Multiple RCTs and clinical evidence
- Reverse the fibroblast senescence

- Reduce the recurrence of ulcers

Centella asiatica is the BEST plant for VLU.

3. Mimosa tenuiflora

Main mechanism:

Strong antimicrobial

Anti-biofilm

Collagen regeneration

Anti-inflammatory

Strength: very good for infected chronic wounds and useful for biofilm problems

Shortcoming: limited for angiogenesis effect, not correct for venous insufficiency and low human trials.

Conclusion

Adjunct therapy for infected VLU is not the main healer.

Table 1: Comparison of three plants.

Plant	Reason
Centella asiatica	covers all VLC mechanisms, clinical trials
Mimosa tenuiflora	Best for infection and biofilm
Hibiscus rosa-sinensis	Mild healing, supportive only

Mechanism-based evaluation shows that Centella asiatica is the most effective medicinal plant for venous leg ulcers because it has strong collagen-stimulating, angiogenic, anti-inflammatory, and microcirculation-improving mechanisms, as evidenced by various clinical studies. Hibiscus acts as a supportive healer, while Mimosa tenuiflora is useful mainly for infected ulcers.

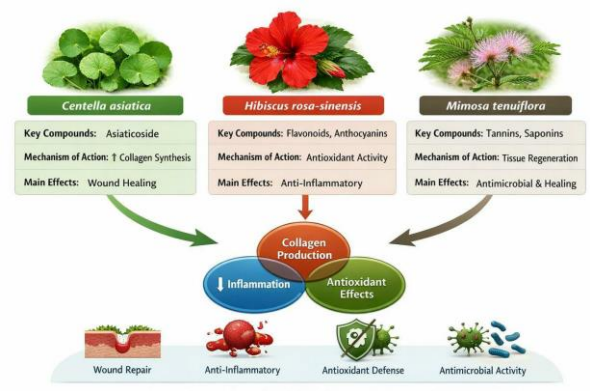

Fig. 5: picture of the comparative mechanism of three plants.

Table 2: Drug parts used for these three plants.

PLANT	DRUG PART	MAIN ROLE
Hibiscus rosa-sinensis	Flower	Anti-inflammatory, wound healing
Centella asiatica	Whole plant	Collagen synthesis, angiogenesis
Mimosa tenuiflora	Bark	Astringent, antimicrobial, and collagen.

DISCUSSION

Venous leg ulcers (VLUs) represent a major clinical challenge due to their chronicity, high recurrence rate, and association with venous hypertension, inflammation, oxidative stress, impaired angiogenesis, and extracellular matrix (ECM) degradation. Conventional therapies, including compression therapy, debridement, and topical antimicrobials, primarily focus on symptom control and infection prevention but often fail to stimulate tissue regeneration actively. In this context, plant-based therapeutics have gained increasing attention due to their multimodal mechanisms of action, lower cost, and improved patient compliance. The present review comparatively evaluates Centella asiatica, Hibiscus rosa-sinensis, and Mimosa tenuiflora based on their mechanistic roles in wound healing and their relevance to the pathophysiology of VLUs.

1. Mechanistic convergence and synergy:

Among the medicinal plants tested, Centella asiatica showed the broadest range of activity in wound healing. The known triterpenes in Centella asiatica, including asiaticoside and madecassoside, have been shown to increase collagen synthesis, promote angiogenesis by stimulating vascular endothelial growth factor (VEGF), and inhibit inflammatory mediators. Additionally, Centella asiatica improves microcirculation and venous tone, which directly targets the underlying pathology of venous insufficiency. Although the activity of Hibiscus rosa-sinensis is significant due to its anti-inflammatory and antioxidant properties, it is less active regarding collagen maturation and angiogenesis, making it more suitable as a supportive wound-healing agent. Mimosa tenuiflora has high antimicrobial and antibiofilm properties, which are beneficial in infected chronic wounds; however, its limited angiogenic potential and insufficient clinical safety data restrict its use as a primary therapy for venous leg ulcers.

2. Limitation

Heterogeneity in extract standardisation and dosage

- Small sample sizes in clinical trials
- Lack of long-term follow-up and safety data

- Minimal mechanistic biomarker profiling in humans.

3. Safety consideration

Generally well-tolerated, although possible cases of allergic reaction and interaction with conventional drugs make its use challenging.

FUTURE VISION

Future studies should focus on:

1. Standardised extracts:

Active compounds quantified with the ability.

2. Large RCTs

Placebo-controlled studies and multicentre trials with validated outcomes.

3. Mechanistic biomarkers

Collagen turnover biomarkers, cytokine profiles, and genomic response.

4. Combination therapies

Herbal products as an addition to compression and conventional wound care.

5. Formulation studies

Nanoparticle delivery, hydrogels, and sustained-release systems.

CONCLUSION

Venous leg ulcers are chronic wounds caused by venous hypertension, inflammation, oxidative stress, impaired angiogenesis, and defective collagen remodelling, making their management complex and prolonged. Medicinal plants such as Hibiscus rosa-sinensis, Centella asiatica, and Mimosa tenuiflora offer therapeutic potential due to their anti-inflammatory, antioxidant, angiogenic, collagen-promoting, and antimicrobial properties. Among these, Centella asiatica appears most relevant to venous ulcer pathology, while Hibiscus rosa-sinensis and Mimosa tenuiflora serve supportive roles. Although these plants show promise as adjuncts to conventional therapy, further standardised clinical studies are required to establish their safety and efficacy. Integration of phytotherapy with standard wound care may provide a complementary approach in the management of venous leg ulcers.

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