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Review Article: Aloe vera, Centella Asiatica, and Calendula

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ABSTRACT

Three commonly used medicinal plants—Calendula offinalis, Centella Asiatica, and Aloe vera—are thoroughly reviewed in this article. The medicinal qualities of each of these plants have been well researched and have a long history in traditional medicine. Their pharmacological effects, active ingredients, botanical traits, and possible medical and cosmetic uses are outlined in the review. Aloe vera is a succulent perennial herb that is a member of the Asphodelaceae family and can withstand drought. Because of its ability to cure wounds and burns, it is also known as the silent healer or the healing plant. For millennia, people have utilized aloe vera for its medicinal, skin-care, cosmetic, and health benefits. It is also a common ingredient in many commercial products. Centella asiatica, commonly referred to as gotu kola, is a traditional herb that is prized for its ability to promote wound healing and skin health. Recent studies have shed additional light on its effectiveness, especially when applied topically. Calendula officinalis is a fragrant perennial herbaceous plant that has a limited lifespan. Calendula officinalis has also been shown in scientific studies to increase the activity of wound healing. Although the exact mechanism is still unknown, it was thought that the herb would improve blood flow to the wound site, delivering oxygen and nutrients required for tissue repair.

Keywords- Calendula officinalis, Centella asiatica, Aloe vera, Medicinal plant, Traditional medicine, Wound healing, Skin health, Pharmacological effects, Active ingredient, Botanical traits.

I. INTRODUCTION

1. Aloe Vera

Aloe vera has been used for medicinal purposes since 6000 B.C. The Sumerian plates from 2200 BC demonstrate the usage of this plant as a medication.[1] The genesis of this plant, which has 240 species and is always green, is described in those plates. Cleopatra claimed that the aloe vera plant was the reason behind her beauty. Aloe vera is used to treat a variety of illnesses, according to a 1550 BC prescription. People in Egypt and Greece were aware of it; for instance, Aristoteles describes the unique qualities of aloe vera. For many years, the plant's extracted jelatin has been used to treat cuts, burns, and inflammatory scars. Additionally, the beverage, medicinal, and cosmetics industries employ it.

According to numerous studies published in X-ray-related journals, it helps heal skin damaged by X-rays. Since this plant contains a high concentration of water and oil, it helps shield burned or wounded skin from drying out. [2]

Figure 1: Aloe Vera

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2. Centella asiatica

Formerly known as Hydro cotyle asiatica (L.), Centella asiatica (L.) Urban is a member of the Apiaceae family, which includes 20 species. Other names for this therapeutic herb include Thick-leaved Pennywort, Asiatic Pennyworth, Indian Pennywort, Gotu kola in the West, Brahmi in Unani medicine, and Mandookaparni in Ayurveda. It is commonly found in tropical South-East Asia, parts of China, India, South Africa, South America, and Eastern Europe. [3,4]

At the nexus of conventional and contemporary medicine is C. asiatica. In India, where it is referred to as Brahmi, or "brain food," it has been utilized since ancient times, especially as an adaptogen to improve cognitive performance. It is referred to as Mandooka Pari in Ayurveda. The C. asiatica plant is used medicinally for its leaves, roots, and stems.

Figure 2: Centella Asiatica

3. Calendula

The genus name Calendula (Calendula officinalis L.) comes from the Latin word Calendae, which means "first day of each month." Calendula belongs to the family Asteraceae and the order Asterales. According to the Missouri Botanical Garden (Mobot, 2013), the genus has 29 species, including the herbaceous Calendula officinalis L., which is grown extensively for decorative, therapeutic, and cosmetic reasons in many nations.[5]

Because of the plant's high saponin content and the gums' and mucilages' high wetting capacities, calendula is used cosmetically in moisturizing lotions for both pre- and post-exposure to the sun. Calendula also possesses antibacterial and therapeutic qualities, acting as an analgesic and sudorific, affecting the bile duct, anti-inflammatory, antiviral, and anti-emetic, and toning the skin through vasodilation (Martins et al., 2004). A 5% calendula tincture has been shown by Pagnano et al. (2008) to have a beneficial effect on the production of fibroblasts, which are new cells involved in wound healing, and to provide more satisfying healing than other treatments when given to rabbit experimental wounds.[6]

Figure 3: Calendula

II. ALOE VERA

1.Botanical description

Aloe barbadense miller is the botanical name for aloe vera. Succulent, pea-green, perennial, xerophytic, shrubby, or arborescent, it is a member of the Asphodelaceae (Liliaceae) family.[7] The aloe plant has long, triangular, fleshy leaves with spikes around the margins that can grow up to 20 inches long and 5 inches wide. The fresh, clear parenchymal gel from the leaf's centre is often dried to make aloe vera concentrate or diluted with water to make items made from aloe juice.[8] The yellowish green pericyclic tubules that line the leaf (rind) are the source of the sticky latex liquid; these tubules are what produce the laxative anthraquinones. The yellow blossoms are not utilized medicinally.

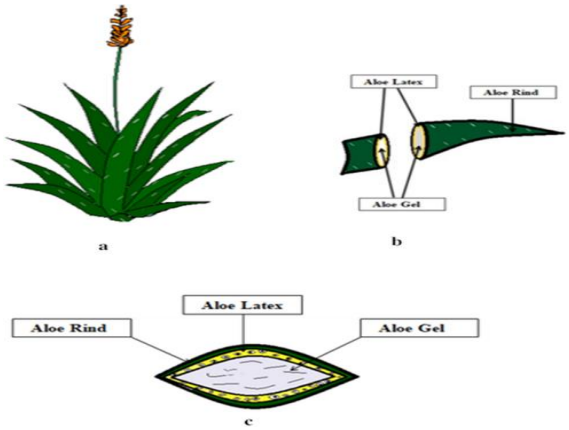

Figure 4: Aloe Vera structure.

2. Active Constituents

Since aloe vera is a succulent plant with a large capacity for internal water storage, water makes up between 99 and 99.5% of its chemical composition (Kumar et al., 2019). Numerous fat and water-soluble substances, such as minerals, amino acids, enzymes, vitamins, polysaccharides, phenols, sterols, and other organic compounds, make up the remaining portion (Boudreau, Beland, 2006; Hashemi, Madani, Abediankenari, 2015). Approximately 55% polysaccharides, 17% sugars, 16% minerals, 7% amino acids, 4% fatty acids, and 1% phenolic chemicals make up aloe gel.[9]

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Table: 1 Active constituents in Aloe Vera with properties.

Name of Active Constituents	Active constituents present in Aloe Vera with Properties
Vitamins	Vitamin A (beta-carotene), C and E, - antioxidant. It also contains vitamin B1, B2, B6, and B12, folic acid, choline. *Antioxidants protect the body by neutralizing free radicals.
Enzymes	Alliinase, alkaline phosphatase, amylase, oxidase, brady kinase, Carboxypeptidase, catalase, cellulose, lipase, cyclooxygenase, and peroxidase. *Brady kinase helps to reduce excessive inflammation when applied to the skin topically, while the other enzyme helps in the breakdown of sugars, proteins, and fats,
Minerals	Calcium, chromium, copper, selenium, magnesium, manganese, potassium, sodium and zinc. *Some of the minerals are essential for the proper functioning of various enzyme system in different metabolic pathways and few act as antioxidant.
Sugar	Monosaccharides (glucose and fructose) and polysaccharides (glucomannans/polyominos). *The most prominent monosaccharide is mannose-6-phosphate, and the most common polysaccrides are called glucomannans [beta-(1,4)-acetylated mannan]. *Ace Mannan a prominent glucomannans has also been found.
Organic acids	Sorbate, salicylic acid, uric acid. *Salicylic acid possesses anti-inflammatory and anti-bacterial properties,
Anthraquinones	Aloin, barbaloin, isobarbaloin anthranilic, aloetic acid, aloe-emodin, ester of cinnamic acid, resistonal, chrysophannic acid and emodin. *Acts as laxatives. *Aloin and emodin act as analgesics, antibacterial properties.

III. PHARMACOLOGICAL ACTIVITIES

3.1. Wound healing

Numerous researchers have suggested that tannic acid [10] and a particular kind of polysaccharide [11] may be useful ingredients for wound healing. Following topical and oral Aloe vera, other researchers have also reported that glucomannan, a mannose-rich polysaccharide, and gibberellin, a growth hormone, interact with fibroblast growth factor receptors to stimulate fibroblast activity and proliferation, which in turn greatly increases collagen synthesis [12]. Aloe gel altered the composition of collagen and raised the degree of collagen cross linking in addition to increasing the wound's collagen content. As a result, it increased the breaking strength of the resultant scar tissue and sped up wound contraction. There have been reports of an increase in hyaluronic acid and dermatan sulphate synthesis in the granulation tissue of a wound that is healing after oral or topical treatment.

3.2. Anti-inflammatory Activity

Arachidonic acid is the precursor to the eicosanoid molecules prostaglandins and thromboxane. Most tissues and organs have these signalling molecules, which are essential for coordinating intricate inflammatory responses [13,14,15]. Two isoforms of cyclooxygenases are used in the synthesis of eicosanoids. It has been demonstrated that cyclooxygenase (COX) gene knockout in mice affects inflammatory responses [16]. By focusing on the arachidonic pathway that generates these chemicals, nonsteroidal anti-inflammatory medications (NSAIDs) and corticosteroids are used in clinical settings to lessen the inflammatory response. By inhibiting COX, extracts of the phytochemical components found in aloe vera have shown anti-inflammatory and vasodilatory properties [17]. Fresh aloe vera has high levels of salicylic acid, a recognized COX inhibitor [18]. Numerous plants contain aromatic chemical molecules called anthraquinones. Aloe contains anthraquinone derivatives called emodin and emodin, which have strong anti-inflammatory effects and function as competitive inhibitors of thromboxane synthetase [19].

3.3. Skin Hydration

Currently, aloe vera is used in the production of almost 95% of the valuable dermatological products. This is as a result of its remarkable moisturizing qualities.

It enhances the skin's capacity to retain moisture and aids in the elimination of dead skin cells. It accomplishes this by generating elastin and collagen fibres, which increase the skin's elasticity Stanic46 studied the genotoxicity of the direct-acting mutagen in adult drosophila. Aloe gel's polysaccharide component demonstrated anti-genotoxic and chemo preventative properties by inhibiting the development of benzo[α]pyrene-DNA adducts.[20] Aloe polysaccharides

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are thought to have anti-cancer properties through stimulating the immune system. [21,22] By inducing glutathione S transferase and inhibiting the tumour-promoting impact of phorbol myristic acetate, aloe gel has been shown to play a significant role in chemoprevention.

3.4. Anti-oxidant Activity

Naturally occurring cellular oxidative phosphorylation in phagocytosis, cytochrome oxidation, and the inflammatory process results in reactive oxygen species (ROS). Superoxide dismutase and glutathione synthetase are the two main antioxidant enzymes that the body normally keeps in balance. The equilibrium is upset in the presence of elevated oxidants (tissue damage), which can lead to homeostatic dysfunction and local or systemic repair [23].

Antioxidants have a crucial function in preventing the systemic consequences of oxidative species as a supplement to primary intervention. It has been demonstrated that tissue ischemia and oxidative damage can be decreased by strengthening the body's natural enzymatic defences against ROS [24]. Aloe vera's glutathione peroxidase activity, superoxide dismutase enzymes, and phenolic antioxidants all exhibit a dose-dependent antioxidant effect [25,26]. Similarly, NAE-8: supports the preservation of cellular integrity and encourages a decrease in lipid peroxidation. Using this extract, Akgun et al. demonstrated a decrease in high levels of glutathione, myeloperoxidase, and malondialdehyde in burns, suggesting a less inflammatory response due to aloe's strong antioxidant properties [27].

IV. MEDICINAL USES

Anthelmintic, cathartic, carminative, deobstuent, depurative, diuretic, stomachic, and emmenagoge are some of the properties of aloe vera. Juice is used to treat a variety of conditions, including the stomach, tumours, dropsy carbuncle's, sciatica, lumbago, tooting, smolders, colic, hyperdenosis, hepatopathy, plexopathy, hindrance, run, menorrhea, and dyspepsia. Aloe Vera gel is very beneficial for weight ulcers and ulcerative colitis. [28]

- Mild to moderate burns.
- Erythema.
- Genital herpes.
- Seborrheic dermatitis.
- Type 2 diabetes.
- Skin moisturizer.
- Oral lichen planus infections.

Centella Asiatica

1. Botanical Description

Centella asiatica (CA), a clonal perennial herbaceous creeper that grows up to 1800 meters in elevation and is found all over India, is a member of the Umbellifer (Apiceae) family. It grows in swampy regions in most tropical and subtropical nations, including sections of Madagascar, India, Pakistan, Sri Lanka, South Africa, and South Pacific and Eastern Europe. About 20 species are associated with CA. grow in rocky, higher elevations as well as most tropical or moist pantropical regions, including rice paddies [29]. It is an odourless, tasteless plant that grows well in and near water. It grows tiny oval fruit and features tiny fan-shaped green leaves with white or light purple-to-pink or white flowers. In the middle of the 20th century, CA and its alcohol extracts were said to have demonstrated promising outcomes in the treatment of leprosy in Western medicine.[30]

Figure 4: Centella Asiatica leaves.

4. Active Constituents

The bioactive substances found in Centella asiatica, primarily triterpenoid saponins (asiaticoside, madecassoside), flavonoids, and phenolic acids, are what give it its medicinal properties.[31] By boosting collagen production, lowering oxidative stress, and modifying inflammatory pathways, these components support wound healing, anti-inflammatory, and antioxidant benefits.[32]

Centella asiatica, also referred to as gotu kola, is a medicinal herb whose bioactive components are responsible for a variety of pharmacological characteristics.[33] The primary active ingredients in Centella asiatica are summarized in the table below:[34]

Table 2: Active constituents of Centella Asiatica.

Active Constituent	Category	Pharmacological Activity
Asiaticoside	Triterpenoid Saponin	Wound healing, anti-inflammatory, neuroprotective
Madecassoside	Triterpenoid Saponin	Antioxidant, anti-inflammatory, skin regeneration
Asiatic Acid	Triterpenoid	Anti-inflammatory, anti-cancer, neuroprotective
Madecassic Acid	Triterpenoid	Antioxidant, wound healing, anti-inflammatory

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Flavonoids (e.g., quercetin, kaempferol)	Flavonoids	Antioxidant, neuroprotective, vascular support
Phenolic Acids (e.g., caffeic acid)	Phenolic Compounds	Antioxidant, antimicrobial
Tannins	Polyphenols	Antioxidant, antimicrobial, astringent
Sterols (e.g., beta-sitosterol)	Sterols	Anti-inflammatory, skin barrier repair

V. PHARMACOLOGICAL ACTIVITIES

a. Wound healing Activity

C.asiatica's total triterpenoid fraction raised the proportion of collagen in cell layer fibronectin, which may aid in wound healing [35]. Peptidic hydroxyproline has been shown to rise in response to Asiatic acid and Medacassic acid from C. Asiatic, indicating a greater modification of collagen production in wounds [36]. An increase in the amount of DNA, protein, and collagen in the granulation tissues of rat dermal wounds demonstrated that oral and topical treatment of an alcoholic extract enhanced cellular proliferation and collagen synthesis at the wound site.

The high stability of the acid-soluble collagen, as well as the rise in aldehyde content and tensile strength, demonstrated that the extract-treated rats had faster and better collagen maturation and cross-linking. When compared to control wounds, it was discovered that the extract-treated wounds epithelialized more quickly and contracted at a higher rate [37].

b. Antimicrobial Activity

Drug resistance has significantly increased as a result of the widespread use of antibiotics during the previous few decades. C. asiatica is a vital medicinal herb that is commonly used to treat a wide range of ailments [38]. Ethanol extracts of C. asiatica (not further specified) demonstrated antibacterial properties against human pathogenic bacteria, including Salmonella species, Vibrio cholerae, Mycobacterium tuberculosis, Bacillus subtilis, Proteus vulgaris, Streptococcus pyogenes, Staphylococcus aureus, Bacillus subtilis, Escherichia coli, and Salmonella typhi, according to a preliminary investigation.

Additionally, C. asiatica's ethanol extract shown efficacy against Gram-negative bacteria. The methanolic extract showed efficacy against methicillin-resistant Staphylococcus aureus (MRSA) and Staphylococcus aureus in a different investigation [39]. Furthermore, Fusarium oxysporum, Aspergillus flavus, Penicillium species, and Cladosporium cladosporioides were all susceptible to the antifungal effects of C. asiatica's aqueous extract.

c. Antioxidant Activity

Because of the growing desire to substitute natural antioxidants for synthetic ones, researchers and the food business are very interested in the antioxidant qualities of essential oils and other extracts from a wide variety of plants [40]. It is commonly known that Centalla asiatica exhibits strong antioxidant properties. Centella asiatica has extremely strong potential to be investigated as a source of natural antioxidants and exhibits antioxidant activity that is comparable to that of sage and rosemary [41]. The antioxidant content of Centella (84%) is similar to that of grape seed extract (83%) and vitamin C (88%).

It is thought that C. asiatica's antioxidant activity stems from its capacity to chelate metal ions, decrease hydroperoxides, or inactivate free radicals. Scavenging reactive oxygen species, preventing the production of free radicals, stopping oxidative chain reactions, and metal chelation are some of the functional characteristics that make up C. asiatica's antioxidant capabilities. C. asiatica has strong neuroprotective properties in addition to being a strong antioxidant, and it has been shown to be successful in shielding the rat brain from oxidative damage brought on by aging [42].

d. Anti-inflammatory Activity

Human health depends on the immune system, which treats illnesses and protects the body against invasive germs. The advantages of C. asiatica extracts, which contain natural antioxidants such saponins, include a significant effect on skin hydration and the function of the epidermal barrier, with an emphasis on tightening the barrier [43]. The saponins, particularly asiaticoside, which can inhibit cyclooxygenase (COX) and lipoxygenase activity as well as pro-inflammatory cytokines, are primarily responsible for the anti-inflammatory qualities of C. asiatica extract (70% ethanol extract, containing 10% active constituents, i.e., madecassoside acid, Asiatic acid, and asiaticoside). With their anti-inflammatory and antioxidant properties, saponins, flavonoids, and phenolic acids can lessen erythema and enhance the function of the epidermal barrier, facilitating a speedier return to homeostasis following exposure to irritants.

Of the many components, triterpenoid saponins are principally in charge of therapeutic benefits such as prostaglandin E2 (PGE2)'s mild anti-inflammatory effects.

After three hours, the aqueous and alcoholic extracts of C. asiatica (not further described) showed 46.31% to 71.18% edema inhibition, which is similar to the 66.66% inhibition seen with ibuprofen [44]. Through the regulation of catalase and superoxide dismutase (SOD), Asiatic acid specifically decreased paw edema. The methanolic extract considerably reduced inflammation, but marginally less than indomethacin, according to a different study that assessed paw size before and after carrageenan injection.

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The capacity of C. asiatica extracts (DER 1:20, lyophilized) and bioactive components to inhibit the inflammatory pathway enzyme, COX, which catalyses the synthesis of PGE2, was used to assess their anti-inflammatory potential. C. asiatica contains madecassoside acid, which has anti-inflammatory properties via suppressing the expression of COX and iNOS. Extracts containing madecassoside and Asiaticoside inhibited COX-1 and COX-2 and decreased the amount of PGE2 that TPA generated [45]. While aqueous extracts demonstrated more antioxidant potential, ethanol and methanol extracts were more effective COX inhibitors and PGE2 suppressors, suggesting that hydrophobic solvents such as ethanol and methanol are better at removing the anti-inflammatory properties of C. asiatica.

VI. MEDICINAL USES

Centella asiatica, also referred to as gotu kola, is a herb used for centuries in traditional Chinese medicine and Ayurvedic medicine [46]. It is prized for having a high concentration of triterpenoids, flavonoids, and antioxidants, all of which support its many medicinal uses. Here is a brief summary of its main medical applications:

- Wound Healing
- Memory Enhancement
- Skin Health
- Venous Insufficiency
- Anti-Inflammatory
- Diabetes Support
- Anti-Anxiety
- Anti-Cancer Potential
- Immune Booster

Calendula

1. Botanical Description

Calendula officinalis is a fragrant perennial herb with slack or upright stems that rarely branch and reach a height of 80 cm. The leaves have an oblong-lance form. The tube-shaped, bisexual disc inflorescences are 5–17 cm long, hairy on both sides, and have continuous, occasionally wavy, or slightly toothed margins [47]. In the wild plant, there is only one structure of ray inflorescences enclosing the central disc florets; these are yellow in colour compared to the female, tridentate, ancillary flowers, and have a thick capitulum or floral head that is 4–7 cm in diameter and surrounded by two rows of hairy bracts. The blooms may bloom all year long if conditions permit [48]. An arching, thorny achene is the fruit. The scent of calendula officinalis is mild and pleasant. The taste is harsh.

Figure 5: Calendula plant.

2. Active Constituents

A common medicinal plant in both ancient and contemporary herbal therapy is calendula officinalis, also referred to as calendula or marigold. Its flowers, leaves, and other plant components contain a wide variety of bioactive chemicals that contribute to its therapeutic effects [49]. Numerous pharmacological characteristics, such as anti-inflammatory, antioxidant, antibacterial, wound-healing, and immunomodulatory effects, are displayed by these substances. Because of its capacity to encourage tissue healing and lower inflammation, calendula is especially prized in skin care and wound care.

The main active ingredients of calendula are listed in the following table along with their corresponding characteristics:

Table 3: Active Constituents of Calendula.

Category	Active Constituents	Functions/Properties
Flavonoids	Quercetin, Isoquercitrin, Rutin, Lutein	Anti-inflammatory, antioxidant, and wound-healing effects
Triterpenoids	Calenduloside, Faradiol, Arnidiol	Anti-inflammatory, antimicrobial, and skin-healing effects
Carotenoids	Beta-carotene, Lycopene, Zeaxanthin, Violaxanthin	Antioxidant and skin-protective effects
Essential Oils	Sesquiterpene	Antimicrobial and

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	s (Cadinene, Caryophyllene)	anti-inflammatory properties
Polysaccharides	Galactose, Arabinose, Glucose	Immunostimulant and moisturizing effects
Phenolic Acids	Caffeic acid, Chlorogenic acid	Antioxidant and anti-inflammatory properties
Sterols	Sitosterol, Stigmasterol	Skin-healing and anti-inflammatory benefits
Saponins	Calenduloside s	Anti-inflammatory and soothing effects
Resins	Calendulin	Antimicrobial and protective against infections

VII. PHARMACOLOGICAL ACTIVITY

7.1. Anti-inflammatory Activity

Since CO has strong anti-inflammatory properties, it is presently being studied [50]. The plant contains a variety of secondary metabolites that are linked to its anti-inflammatory properties, including alkaloids, tannins, flavonoids, essential oils, sterols, saponins, carotenoids, triterpene alcohols, mucilage, polysaccharides, and resin. Plant parts used in medicine and cosmetics include dried flower heads and dried ligulate blossoms. Triterpene alcohols, triterpene saponins, fatty acid esters, flavonoids, carotenoids, coumarins, hydrocarbons, essential oils, and fatty acids are all abundant in ligulate flowers [51]. The anti-inflammatory properties of calendula flowers have been attributed to the triterpenoid fatty acid esters, according to in vivo pharmacological tests. The most common of these are the lauryl, myristoyl, and palmitoyl esters of faradiol, showing that flower extract of CO was significantly more successful in treating mice's acute (induced by dextran and carrageenan) and chronic (produced by formalin) edema. They looked into the effects of CO extract on nitric oxide production and postulated that it might be related to the suppression of proinflammatory cytokine production (IL-6, interleukin 6; IL-1; TNF-, tumour necrosis factor; and IFN-, interferon) and COX-2 (cyclooxygenase 2). The findings showed that the CO extract prevented Cytotoxicity is only seen at concentrations of 147 L/mL or higher, and nitric oxide generation is dosage dependant.

7.2. Wound healing Activity

Calendula flower extract was found to have significant healing activity against thermal burns in rats by raising the content of hexosamine and collagen hydroxyproline while significantly lowering the levels of acute phase proteins (oomycide and haptoglobin) and tissue damage marker enzymes (aspartate transaminase and alkaline phosphatase) [52]. Calendula's antioxidant properties may be the cause of the decrease in lipid peroxidation (Chandran and Kutton 2008). Because of its antibacterial and antioxidant properties, calendula gel (2%) significantly promotes wound healing when used daily (Leach, 2008). By promoting wound angiogenesis, epithelialization, and nucleoprotein, glycoprotein, and collagen metabolism, calendula may aid in wound healing by enhancing local circulation and granulation tissue production (Leach, 2008). In addition to being more effective than other medications, calendula also lessens discomfort when changing dressings. When used to clean burns, venous ulcers, and skin lesions, 10% calendula solution enhanced with 2% calendula gel speeds up the healing process and adds leads to more wounds being cured than when calendula solution is used alone (Leach, 2008). Nevertheless, this evidence is insufficient and needs more research. By arranging the collagen proteins and raising the concentration of collagen and non-collagen proteins, topical administration of C. officinalis cream promotes achilles tendon repair [53].

7.3. Anti-oxidant Activity

Alkaloids, carotenoids, flavonoids such as quercetin, lupeol, protocatechuic acid, isorhamnetin, etc., and triterpenoids are among the phytochemical elements found in C. officinalis (Matysik et al., 2005). The majority of these phytochemicals have the ability to scavenge free radicals and promote wound healing by artificial cross-linking (Kuppas and Nayak 2006). With its abundance of flavonoids, carotenoids, saccharides, organic acids, lipids, and saponosoides, C. officinalis has potent antioxidant properties. Flavonoids and carotenoids both prevent the generation of free radicals and other reactive oxygen species, which can otherwise result in autoimmune and chronic inflammatory disorders in people, such as broiler pulmonary hypertension syndrome (ascites) (Iqbal et al., 2002) [54]. Because of their ability to inhibit oxidases, activate antioxidant enzymes, chelate metal catalysts, transfer free radical electrons, and decrease alpha-tocopherol radicals, flavonoids and carotenoids prevent oxidation (Middletone et al., 2000; Nijveldte et al., 2001). Numerous farm animals' performance can be enhanced by bio-flavonoids, which can lessen oxidative stress (Abd El-Gawad et al., 2001; Hager-Theodorides et al., 2014).

According to Hou and Kumamoto (2010), flavonoids may preferentially interact with a variety of protein kinase signalling cascade components, including Akt/protein kinase B, as phosphoinositide 3-kinase, and protein kinase C. Additionally, the extract from C. officinalis exhibits action against Both reactive nitrogen species (RNS) and reactive oxygen species (ROS) have a strong effect even at low focus (Braga et al., 2009) [55]. The butanoic component of C. officinalis has strong antioxidant and free radical scavenging properties in vitro (Cordova et al., 2002). The concentration of superoxide radicals (O2-) and hydroxyl radicals (OH-) was reduced by the butanoic fraction (BF). Additionally,

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in rat liver microsomes, BF demonstrated 100% prevention of lipid peroxidation brought on by Fe2+/ascorbate.

7.4. Anti-bacterial and Antifungal Activity

Calendula has been used to treat wounds, eczema, burns, ulcers, skin inflammations, and abrasions due to its numerous antibacterial and antifungal properties (Rossiteret al., 2006; Tonkset al., 2007). (Schulzet al., 2004). A variety of bacteria are susceptible to the antibacterial properties of CO flower extract [56]. Gram-positive bacteria like Staphylococcus aureus and Bacillus subtilis as well as gram-negative bacteria like Pseudomonas aeruginosa and Escherichia coli were hindered in their development by the essential oil of flowers in vitro, with Pseudomonas aeruginosa exhibiting the greatest suppression. Furthermore, CO's petals exhibit stronger antibacterial activity than its reproductive organs (Hamadet al., 2011). Several facultative aerobic and obligatory anaerobic periodontal bacteria, such as Furobacterium nucleatum, Porphyromonosgingi valis, Caphocytophagagingivalis, Prevotella spp., Veilonella parvula, Peptostreptococcus micros, Eikenella corrodens, and Actinomycesodontolyticus, were inhibited by the flower decoction and methanolic extract (Iauket al., 2003) [57]. Several fungal strains, including Candida dubliniensis (ATCC777), Candida krusei (ATCC6258), Candida glabrata (ATCC90030), and Candida albicans (ATCC64548), were susceptible to the antifungal activity of the floral volatile oil. Compared to ethanolic, methanolic, and petroleum ether extracts of calendula flowers, Streptococcus aureus was more vulnerable to the aqueous extracts, indicating that aqueous extracts had superior antibacterial action (Roopashree et al., 2008). Extracts from calendula leaves, stems, roots, and flowers exhibit antimicrobial action against a variety.

7.5. Nephroprotective Activity

CO flower extract lessens kidney damage and prevents oxidative stress caused by cisplatin (cis-dichloro diamine platinum II/platinum-containing anti-cancer medication) (Preethi et al., 2009). Nephrotoxicity results from the buildup of platinum in the kidneys. Because calendula extract has antioxidant properties, it lessens kidney damage [58]. The extract-treated group is protected against cisplatin-induced kidney injury due to enhanced SOD, CAT, and GSH activities (Preethi et al., 2009).

8. Medicinal Uses

A well-known and versatile herb in contemporary herbal therapy, pot marigold is also a common home remedy [59]. It is mostly used to treat skin conditions like varicose veins, bug bites, ripped ligaments, cuts, eye discomfort, and soon. In addition, it is used to cure persistent infections and high fevers as a cleansing and exfoliating herb. The typical deep-orange flower variety is the only one believed to have therapeutic value [60]. The whole plant has cholagogue, diaphoretic, emmenagogue, skin, stimulant, vulnerary, antiphlogistic, antispasmodic, aperient, astringent, and diaphoretic properties. The leaves are best grown in the morning of a lovely, sunny day, right after the wetness has dissipated, and they can be utilized either fresh or dried. The blooms can be used both fresh and dried; to dry them, they should be cultivated in an open environment and quickly dried in the dark. When taken consistently, a tea prepared from the petals can aid with varicose veins and increase blood circulation. Corns and blemishes treated with crushed stems will soon make, they are simple to take out [61]. Leaves, flowers, and buds are used to make homeopathic treatments. It's employed internally to lessen inflammation and edema.

VIII. COMPARATIVE ANALYSIS

Table 4: Comparative Analysis

Properties	Aloe Vera	Calendula	Centella Asiatica
			
Wound healing	Prominent	Prominent	Prominent
Anti-inflammatory	Dominant	Strong	Strong
Anti-Microbial	Strong	Moderate	Moderate
Skin benefits	Hydration, Elasticity	Soothing, Regeneration	Anti-ageing, Strech marks
Cognitive benefits	None	None	Present

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IX. CONCLUSION

Three medicinal plants—Centella asiatica, Calendula officinalis, and Aloe vera—have different but complimentary therapeutic qualities. Aloe vera is well known for its antibacterial properties, ability to heal wounds, and ability to hydrate the skin. Calendula is notable for its calming and anti-inflammatory properties, especially when it comes to treating damaged and irritated skin. Centella asiatica is useful in both dermatological and neurological applications because it makes a substantial contribution to wound healing, anti-aging, and cognitive enhancement. When combined, these plants provide a safe, all-natural way to support healthy skin and overall wellbeing. Future studies should focus on developing novel uses that fully utilize these plants' potential and investigating their synergistic effects in combination formulations. These medicinal plants can maintain their crucial function in healthcare and cosmetics by fusing traditional knowledge with contemporary scientific discoveries.

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