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Medicinal Uses (Wound Healing) and Pharmacological Properties of *Chromolaena Odorata*: A Review

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A B S T R A C T
Eupatorium odoratum, also known as *Chromolaena odorata* (Family: Asteraceae), is a traditional medicinal plant that is well-known for its capacity to cure wounds. Particularly, the various components of this herb have been utilised to treat skin infections, burns, and wounds. It has also been demonstrated to have antioxidant, anti-hepatotoxic, anti-inflammatory, anticancer, and anti-diabetic properties. Alkaloids, flavonoids, flavanone, essential oils, phenolics, saponins, tannins, and terpenoids are some of its phytochemical constituents. The plant also contains significant amounts of eupolin, chromomoric acid, quercetagetin, and quercetin, all of which support the plant's therapeutic qualities. The ethnopharmacological qualities of this plant, including its antibacterial, anti-inflammatory, antioxidant, and analgesic action, have been amply documented in the literature. Additionally, it may be used medicinally to treat skin infections, wound healing, and stomach issues. The therapeutic qualities of C. odorata are said to have largely been influenced by the presence of different active chemical components in its leaves and root extracts, including phenolic, essential oils, and flavonoid chemicals. As a result, the goal of this review is to provide an overview of the bioactivities, phytochemical components, and potential therapeutic qualities of C. odorata.

Keywords*:* *Chromolaena odorata, Wound Healing, Traditional Medicine, Invasive Weed, Medicinal Herb, Antibacterial, Anti-Inflammatory*

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INTRODUCTION

WOUND HEALING PLANTS

Ancient wound healing practises have been documented in a number of nations, including the Tirunelveli Hills in southern India, the Northern Himalaya Range in Pakistan's Abbottabad district, several districts in Bangladesh, the Kpando area of Ghana's Volta Region, and the Kuruma tribes of India's Wayanad districts [1]. Many nations, including India, China, and Thailand, are researching the use of natural or biological products as burn and wound healing agents [2]. Wound infection is still one of the most prevalent infections in impoverished nations due to poor hygiene conditions. Korphad, Aloe vera, Madeira vines, Anredera diffusa, Jungle Geranium, Ixora coccinea, Indian Mulberry, Morinda pubescens, Simple-leaf Chaste Tree, Vitex trifolia, and Peacock Chaste Tree, Vitex altissima are a few examples of plants that can cure wounds [3]. The present review provided an up-to-date information about the properties of *Chromolaena odorata*, one of the wound healing plants that is being investigated for its diverse health benefits.

PLANT DESCRIPTION OF CHROMOLAENA ODORATA

Siam weed, or C. odorata, has a minimum lifespan of ten years. C. odorata is a scrambling perennial shrub that can reach heights of two to three metres and has stems that are straight, pithy, brittle, and easily branch. The three veined, arrowhead-shaped leaves have an overall size of 6–12 cm long and 3–7 cm wide. Along the stems and branches, the leaves develop in opposite-paired pairs. Each 10 mm long tubular floret has a variety of hues, including white, purple, pink, and blue, and there are 15–25 of them per head. Brown-gray to black in hue, the seeds are 4-5 mm long, with a pale brown pappus that is 5 to 6 mm long. The roots are fibrous and thin, and they often extend 0.3 km below the surface [4-6]. In its natural habitat, C. odorata exhibits diverse morphology in terms of flower colour, leaf form, smell of crushed leaves, and plant architecture [7].

TAXONOMY

C. odorata belongs to the following taxonomic groups: Magnoliopsida, Superorder Asteranae, Order Asterales, Family Asteraceae, Genus Chromolaena, and Species C. odorata. It also belongs to the following subgroups: Viridiplantae, Subkingdom Viridiplantae, Infrakingdom Streptophyta, Superdivision Embryophyta[8]. The plant genus Chromolaena is one of the Asteraceae family's more than 165 species, which are found in both tropical and subtropical climates. The name comes from a Greek word that means "colour." The leaves have a pungent smell when crushed, hence the species name "odorata." Eupatorium odoratum, often known as C. odorata, is a weedy herb native to Central and South America that has colonised the tropical and subtropical regions [9,10]. It was first introduced as a plant in Africa around 1940 and Southeast Asia in the 1920s [11,12]. Sunflower family, Christmas bush, Jack in the bush, communist weed, Siam weed, and devil weed are some of the common names for C. odorata in English; sekou toure, acheampong, jabinde, matapa, and mighbe are common names for the plant in Africa; herbe du Laos is a French term; Siam kraut is a German term; kesengesil is a Guam term; bagh d (Vietnamese) [12,13].

CHEMICAL CONSTITUENTS

The dried leaf of *C. odorata* contained ash (11%), crude fat (11%), fiber (15%), moisture (15%), crude protein (18%), and carbohydrate (31%)[14]. Its active phytochemical substances are as follows:

(1)Flavonoid aglycones (flavanones, flavonols, flavones) including acacetin, chalcones, eupatilin, luteolin, naringenin, kaempferol, quercetin, quercetagetin, and sinensetin;[15-22]
(2) Terpenes and terpenoids;[23]
(3) Essential oils;[24-29]
(4) Alkaloids including pyrrolizidine;[30-32]
(5) Saponins and tannins;[14]
(6) Phenolic acids including ferulic acid, protocatechuic acid;[33]
(7) Phytoprostane compound including chromomoric acid.[34]

TRADITIONAL USES

From review literature regarding the traditional uses, phytochemical properties of *C. odorata* are anti-bacterial[18,34-38], anticancer [12,39], anticonvulsant [40], antidiabetic [41-43], anti-diarrheal[44,45], anti-fungal[46,47], anti-inflammatory[48-50], antioxidant[51-56], and antiparasitic[21,31], hemostatic and wound healing[6,13,14,57,58], and hepatoprotective activities[59,60].

WOUND HEALING PROPERTY

The antioxidant properties of the medication or plant increase the preservation of fibroblast and keratinocyte proliferation on the wounds, which contributes to the effectiveness of wound healing [13]. In addition to being used for traditional wound healing in Vietnam, C. odorata leaves have also been utilised to treat skin infections and soft-tissue burns[33,51,61,62].

IN-VITRO STUDY

In a wound assay, fibroblasts, endothelial cells, and keratinocytes were found to proliferate more when Eupolin extract was used, according to Phan et al. [61]. There have been reports of keratinocyte migratory stimulation, keratinocyte upregulation of extracellular matrix protein and basement membrane component synthesis, and fibroblast protection of collagen lattice contraction. Additionally, Eupolin extract increased the expression of numerous adhesion complexes, such as laminin-5, laminin-1, collagen IV, and fibronectin, by human keratinocytes, according to Phan et al. According to Pandith et al. [58], C. odorata induced the expression of genes such as heme oxygenase-1, thromboxane synthase, and anti-platelet aggregator matrix metallopeptidase 9 to boost hemostatic process and wound healing activity (MM9). This plant can encourage the migration and proliferation of fibroblast cells. Additionally, they discovered that C. odorata therapy boosted the transcriptional and translational levels of heme oxygenase-1, the enzyme that speeds up wound healing. When C. odorata was used as a treatment, MMP-9, an anti-platelet aggregator, was lowered and thromboxane synthase, a vasoconstrictor, was elevated.

Figure.1*; Chromolaena odorata*

PHARMACOLOGICAL PROPERTIES OF *CHROMOLAENA ODORATA*

Antibacterial Activity

Strong inhibitory effects against Gram-positive (Bacillus cereus, Enterococcus faecalis, Staphylococcus epidermidis, Staphylococcus aureus, Streptococcus pyogenes, and Propionibacterium acnes) and gram-negative (Proteus vulgaris) bacterial strains have been reported for the ethanol, methanol, and hexane-extracted leaf extracts of [63]. Hexane extract of the C. odorata stem demonstrated greater inhibitory activity against Pseudomonas aeruginosa, Bacillus cereus, and Klebsiella pneumoniae in comparison to the leaves extract, while the extract of the root demonstrated strong inhibitory activity against Enterococcus faecalis and K. pneumoniae. Additionally, the results showed that the ethanolic and methanolic leaf extracts had good extraction yields and high concentrations of total phenolics and flavonoids. Additionally, it has been noted that these extracts showed good antibacterial action against the gram-positive bacteria P. vulgaris and the gram-negative bacteria Staphylococcus S. aureus, S. pyogenes, and S. epidermidis. The findings indicated that C. odorata leaf extracts in ethanol, methanol, and hexane are potential for further development in the treatment of bacterial skin infections [63]. Furthermore, it has been noted that extracts of C. odorata leaves from four different solvents, including cyclohexane, dichloromethane, ethyl acetate, and butanol, showed antibacterial activity against four types of bacteria, including Shigella sonnei, Vibrio cholera, Salmonella enterica, Klebsiella oxytoca, and Salmonella enterica. This supports the plant's historical usage in the management of intestinal infectious illnesses [8]. The acetone extract of C. odorata exhibited strong inhibitory action against S. aureus and P. aeruginosa, according to a recent study by Udayaprakash et al. [64]. While Streptococcus mutans was strongly inhibited by chloroform extract of C. odorata, Bacillus subtilis was most effectively inhibited by ethyl acetate extract of C. odorata. It is important to remember that the direct solvent extraction method's extracts have been demonstrated to have stronger antibacterial components than the sequential extraction method [64].

Anti-inflammatory Activity

It has also been demonstrated that the C. odorata plants has anti-inflammatory qualities. The aqueous and ethanolic extracts of C. odorata were said to be able to reduce the inflammatory response. The antiinflammatory properties of C. odorata may result from the phenolic chemicals found in these extracts [8]. Additionally, it has been demonstrated that the C. odorata chloroform extract significantly inhibits the generation of nitric oxide. The body naturally produces nitric oxide (NO), a free radical, but excessive NO production can result in a variety of inflammatory processes. Therefore, NO inhibition could stop or lessen the body's inflammatory consequences [9]. Additionally, it was shown that the acid derivatives from the extracts of C. odorata, such as coriolic acid, linoleamide, and didehydrocoriolic acid, are a natural NF-B inhibitor (nuclear factor kappa-light-chainenhancer of activated B cells). An essential mediator of inflammation is NF-B. The fatty acid components of C. odorata are therefore thought to be a therapeutic target for treating inflammation by inhibiting NF-B transcriptional factor [65]. According to reports, flavonoid molecules like chalcones have strong anti-inflammatory properties that also target the NF-B signalling system. By inhibiting the activation of NF-B signalling pathways and causing a decrease in proinflammatory cytokines in LPS-activated macrophages, chalkones have been demonstrated to have antiinflammatory effect. This result supports chalcone's function in decreasing inflammation [66]. The aqueous extract of C. odorata was also able to consistently produce high levels of anti-inflammatory activity in acute and chronic models of inflammation, according to the anti-inflammatory tests that were done. The flavonoid components of C. odorata are thought to be responsible for the body's anti-inflammatory effects [67].

Antioxidant Activity

An vital element in the body called an antioxidant functions by defending the body against any damage or injury that could eventually be brought on by oxidative stress brought on by free radicals. Polyphenols, one of the natural antioxidants found in C. odorata plants, are crucial in protecting the body from oxidative damage. This is because plants are more potent antioxidants against free radical scavenging activity than any other chemicals, such as ascorbate and tocopherols, due to the perfect molecular structure of polyphenols component. By protecting tissues from oxidative damage and creating an environment that is conducive to tissue healing, C. odorata was also able to increase the production of antioxidant at the wound site (1). In essence, reactive intermediates (ROS) can slow the healing of wounds. Alkaloids and flavonoids, two phytochemical components of C. odorata, have also been found to exhibit antioxidant activity that can lessen or control the oxidative damage brought on by ROS formation. Additionally, C. odorata may raise levels of antioxidant enzymes, which can neutralise superoxide and prevent cellular damage caused by free radicals. Consequently, it can aid in the mechanism of wound healing [68]. The high reactivity of polyphenol compounds, which can function as either an electron or hydrogen donor and its capacity to stabilise and remove the unpaired electron, also contributes to the polyphenols' ability to display antioxidant capabilities [9]. The phenolic compound that can be found in crude extracts of C. odorata essentially can work as a metal chelator, reducing agent, free radical quenchers, as well as a hydrogen donor. This function is due to their redox properties that enable the phenolic compounds in this plant to exhibit antioxidant properties [9]. The common solvents for extraction of C. odorata plants that exhibit antioxidant activity include chloroform, ethanol, methanol, and petroleum ether. Overall, the ethanol extract of the leaves demonstrated the most effective antioxidant property [8].

Analgesic Activity

Substances that relieve pain can be defined as analgesics (painkillers). Analgesics works through various mechanisms and function either centrally (opioids receptor agonism) or peripherally. In recent years, there has been an impetus on the use of traditional medicinal plants with analgesic effects worldwide due to its natural origin and lesser side effects [69]. A study by Owoyele et al. [67] reported that C. odorata ethanolic extraction was shown to exhibit analgesic activity through hot plate latency assay and formalin paw licking tests. There were significant increases in the reaction time from 1.80 ± 0.37 to 4.0 ± 0.55 min after 60 min of 100 and 200mg/kg oral administration in the hot plate latency assay. While in the formalin-induced paw licking assay, doses of 25– 200 mg/kg C. odorata ethanolic extract significantly inhibited the early and late phase licking time. The number of writhing incidents also significantly decreased from 16.0 ± 0.37 to 7.0 ± 0.26 at doses between 25 and 200 mg/kg extract administration in the acetic acid induced writhing test. It is postulated that the fraction of C. odorata ethanolic extract contains high amounts of active constituents that is responsible in inhibiting both the centrally and tonic pain induced by hot plate assay and formalin test. The effectiveness of C. odorata extracts to exhibit the analgesic properties might be due to its active phytochemical constituents . The main active constituents responsible for the analgesic property include glycosides, terpenes, flavonoids, steroids, tannins, alkaloids as well as saponins. The effectiveness of C. odorata plant extract on the analgesic properties was reported to be approximately similar to the pentazocine drug. Pentazocine is an opioid pain medication which is sometimes referred to as a narcotic. This drug also works as an analgesic which eventually interacts with kreceptors which in turn causes sedation [70].

CONCLUSION

In conclusion, the evaluation and analysis of the available literature on C. odorata demonstrate that the plant species is invasive to a variety of habitats, including grasslands, by the sides of roads, agricultural fields, forest edges, and disturbed forests. Even though it is invasive, this plant makes a good herbal remedy. Numerous investigations are being conducted to further validate the therapeutic benefits of C. odorata in light of its traditional applications. This review also explains the therapeutic benefits and applications of C. odorata, particularly in the management of wound healing and the treatment of conditions including skin infections and gastrointestinal issues. As a result, taking into account the aforementioned factors, this review may increase our understanding of the positive traits of this plant and create awareness among the local population on its medicinal uses.

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