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Review Article

A PHARMACOGNOSTIC AND PHARMACOLOGICAL REVIEW ON *CHROMOLAENA ODORATA* (SIAM WEED)

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ABSTRACT

Chromolaena odorata is commonly known as Siam weed which belongs to sunflower family Asteraceae. *C. odorata* is an important medicinal plant which can be easily found in tropical Asia, West Africa, and parts of Australia. It is native to the America, and found in Florida and Texas in the United States, throughout Mexico and the Caribbean to South America. The medicinal usage of *C. odorata* has been reported in the traditional systems of medicine such as Ayurveda, Siddha, and Unani. It has wide variety of ethanomedicinal and pharmacological properties. The young leaves are crushed, and the resulting liquid can be used to treat skin wounds. The leaves extract is used by the kani tribals of Kouthalai in Tirunelveli hills to cure skin diseases, poison bites, wounds, and rheumatism. Following various folk claims for the ailment of various diseases, efforts have been made by the researchers to verify the efficacy of this weed through scientific biological screenings. A study of the literature revealed some notable pharmacological activities of the shrub such as anthelmintic, antimalarial, analgesic, anti-inflammatory, antipyretic, antispasmodic, antioxidant, antigonorrheal, antimycobacterial, insecticidal, fungicidal, wound healing, diuretic, blood coagulation, and antibacterial. The current review is created with an intent to focus on the numerous ethnobotanical and traditional uses as well as the phytochemical and pharmacological reports on *C. odorata.*

Keywords: Antioxidant, *Chromolaena odorata,* Healing property, Plant, Traditional medicine, Wound.

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INTRODUCTION

Currently, natural products are a significant source of new compounds, leading to the synthesis of drugs in all major disease areas. They epitomize a pool of structures that have been optimized by evolution to interact with different molecules such as proteins and other molecules [1]. The starting materials for about one-half of the medicines we use today come from natural sources. The future of higher plants as sources of medicinal agents for use in investigation, prevention, cure, and treatment of diseases is also very promising [2]. During the past decade, the traditional systems of medicine have become progressively popular keeping in mind their safety. Natural products proved to be an important source of lead compounds in the development of new drugs [3]. Natural products have provided some of the important lifesaving drugs used in the armamentarium of modern medicine. However, among the estimated 250,000–400,000 plant species, only 6% have been studied for biological activity and 15% have been examined phytochemically [4]. Phytochemicals may protect human from a variety of diseases. Phytochemicals are non-nutritive plant compounds, which have protective, curative, or disease preventive properties. Plants produce these chemicals to protect themselves, but recent research demonstrates that many phytochemicals can protect humans against diseases. There are many phytochemicals in fruits and herbs and each works differently [5]. This illustrates the need for planned activity guided phytopharmacological evaluation of herbal drugs. This article aims to provide an overview of the chemical constituents present in various parts of *Chromolaena odorata* and their ethnobotanical and pharmacological actions. It has been claimed in Ayurveda that *C. odorata* possesses proven medicinal properties and is the ingredient of many formulations.

HABITAT AND DISTRIBUTION

The family Asteraceae comprises over 165 species that are distributed across tropical and subtropical regions. The tropical and subtropical regions are the best for growth of Siam weed, and though not tolerant of cold climate it can be still found at altitudes up to 1000 m. Even though Siam weed grows on most soil types, it preferred well-drained soils in full sun. It has a viable benefit over other plants in weathers with distinct wet and dry seasons because it endures fires and grows back vigorously following rain. It is one of the invasive, fast-growing plants, and thrives in disturbed areas such as meadows, farms, clearings, roadsides, and shores, particularly those in well-lit sites. Siam weed is misleadingly named as it is actually a native of Central and Northern South America, from Mexico to Brazil. Although first introduced into India as an ornamental, it has quickly spread throughout its current range [6].

MORPHOLOGY

C. odorata or Siam weed has a minimum 10-year life span. It is a rapidly growing perennial herb. Siam weed is a big bushy herb or subshrub with long rambling but not having twisted branches. In open areas, it spreads into scrambled and compressed thickets up to 2-meter high. The main stem consists of many paired branches. The base of the plant becomes hard and woody. Branch tips are often soft and green. The arrowhead-shaped leaves have three characteristic veins in a "pitchfork" pattern. Leaves are 4–10 cm long and 1–5 cm wide. They breed in contradictory pairs alongside the stems and branches. The term "*Odorata*" suggests that the leaves release a pungent, aromatic odor when crushed. Light pink-mauve or white tubular flowers, 10 mm long, are found at the ends of branches in clusters of 10–35. The dark-colored seeds are 4–5 mm long, narrow, and oblong, with a parachute of white hairs which turn brown as the seed dries. 80,000–90,000 seeds are produced per plant. Siam weed is native to tropical America but is now acclimatized throughout the tropics [7]. Habit (a), flowers (b), leaves (c), and seeds (d) of Chromolaena odorata are shown in Fig. 1.

Taxonomical classification [8]
Kingdom: Plantae
Subkingdom: Viridiplantae
Infrakingdom: Streptophyta
Superdivision: Embryophyta
Division: Tracheophyta
Subdivision: Spermatophytina
Class: Magnoliopsida

Superorder: Asteranae
Order: Asterales
Family: Asteraceae
Genus: Chromolaena
Species: *C. odorata*.

Nomenclature
C. odorata aka *Eupatorium odoratum* is a weedy herb native of Central and South America, which has spread throughout the tropical and subtropical areas [9,10]. It was first introduced to Southeast Asia in the 1920s and Africa in around 1940 as a plantation cover crop and has ever since spread worldwide (Table 1) [11,12].

Phytoconstituents
The dried leaf of *C. odorata* contained carbohydrate (31%), crude protein (18%), fiber (15%), crude fat (11%), ash (11%), and moisture (15%) [14]. Its active phytochemical substances are as follows:
1. Essential oils [15-17].
2. Flavonoid aglycones (flavanones, flavonols, and flavones) including naringenin, kaempferol, quercetin, acacetin, chalcones, eupatilin, luteolin, quercetagetin, and sinensetin [18-21].
3. Terpenes and terpenoids [22].
4. Saponins and tannins [14].

Table 1: Names used worldwide of *C. odorata* are as follows [12,13]

Language	Vernacular name
English	Devil weed, Christmas bush, Jack in the bush, communist weed, Siam weed
Hindi	Bagh dhoka, tivra gandha
French	Herbe du Laos
German	Siam kraut
Guam	Kesengesil
African	Sekou toure, acheampong, jabinde, matapa, mighbe
Indonesian	Rumput belalang, rumput putih, rumput golkar
Malayalam	Pokok kapal terbang, rumput jepun, rumput Siam
Sanskrit	Ropani, seekhrasarpi
Spanish	Cariaquillo Santa Maria
Tagalog	Agonoi, hagonoy, huluhagonoi
Thai	Sab suea
Vietnamese	Co hoi

C. odorata: Chromolaena odorata

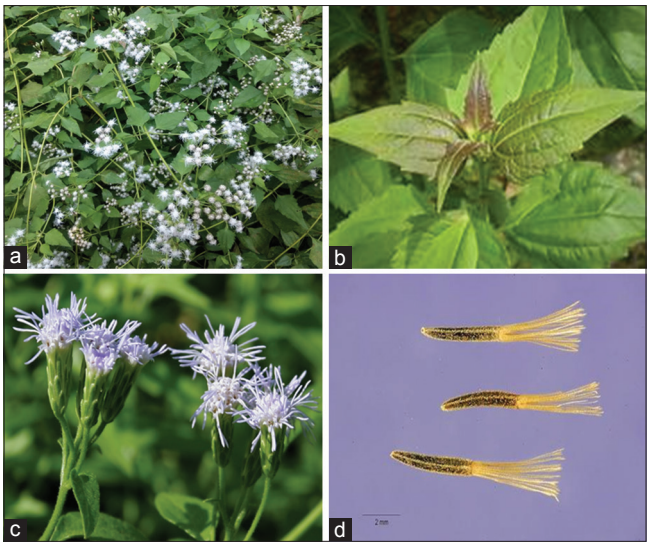

Fig. 1: Habit (a), flowers (b), leaves (c), and seeds (d) of *Chromolaena odorata*

Some major phytoconstituents are shown in Fig. 2.
5. Alkaloids including pyrrolizidine [23-25].
6. Phytoprostane compound including chromomoric acid [26].
7. Phenolic acids including ferulic acid and protocatechuic acid [27].

Traditional uses
From literature review regarding the traditional uses, phytochemical properties of *C. odorata* are antibacterial [28-31], anticancer [32], anticonvulsant [33], antidiabetic [34-36], antidiarrheal [37,38], antifungal [39,40], anti-inflammatory [41-43], antioxidant [44-47], and antiparasitic [24], hemostatic and wound healing [47,48], and hepatoprotective activities [49,50].

PHARMACOLOGICAL ACTIVITIES

C. odorata is found to be a highly efficient medicinal herb according to the traditional and widespread medicinal systems. The same is proved by its pharmacological evaluation performed by scientific community across the world.

Anti-inflammatory, analgesic, and antipyretic activity
C. odorata is traditionally usage in the treatment of rheumatic fever and similar conditions. This is evident for anti-inflammatory, analgesic, and antipyretic activities of the *C. odorata*. In the study conducted by Umukoro *et al.,* 2006, for pharmacological evaluation of the drug extract in different animal experimental models which comprise carrageenan paw edema and cotton pellet granuloma for determination of anti-inflammatory activities, hot plate, and formalin paw licking tests for determination of analgesic activities, and Brewer's yeast induced pyrexia for determination of antipyretic tests.

The result shows that the extract produced dose-dependent anti-inflammatory, analgesic, and antipyretic activities. Other studies have shown that the anti-inflammatory activity may be attributed because of the presence of flavonoids in the extract [51,52].

Antimicrobial activity
The *C. odorata* plant considered and used traditionally for its antimicrobial action, thus the antimicrobial activity of was evaluated in multiple experiments by various researchers.

This antimicrobial activity plays a major role in the aspect of wound healing power, which is expressed by the shrub. The *C. odorata* dichloromethanolic and ethanolic crude extracts have been assessed against 22 strains of microorganisms consisting of various Gram-positive and Gram-negative bacteria and yeasts.

Pisutthanan *et al*., 2005, presented that all crude extracts have shown activity, mainly against Gram-positive bacteria. The extracts have also shown modest activity against *Mycobacterium tuberculosis* [52]. The dichloromethane-water extract of the plant exhibited significant anti-herpes simplex virus-1 and antimalarial activity [52]. Ling *et al*. found out that the activity is particularly stronger against staphylococci [53]. The extract also displayed appreciable antifungal activity [54]. Thoden *et al*., 2007, have also demonstrated profound nematicidal activity of the herb [24].

Antioxidant
The profound antioxidant action of the plant is the basis of its external application of *C. odorata* [51,53]. Phan *et al*., 2001, assessed the plant extract for its antioxidant effects using purified fractions on cultured fibroblasts and keratinocytes. This experiment was evaluated by investigation with the help of colorimetric and lactate hydrogenase release assay.

The results of this test indicated that the phenolic acids, which are present in the extract such as p-coumaric, ferulic, protocatechuic, p-hydroxybenzoic, and vanillic acids, as well as complex mixtures of hydrophobic flavonoid aglycones such as flavones, flavanones, chalcones, and flavonols, were principal and potent antioxidants [27].

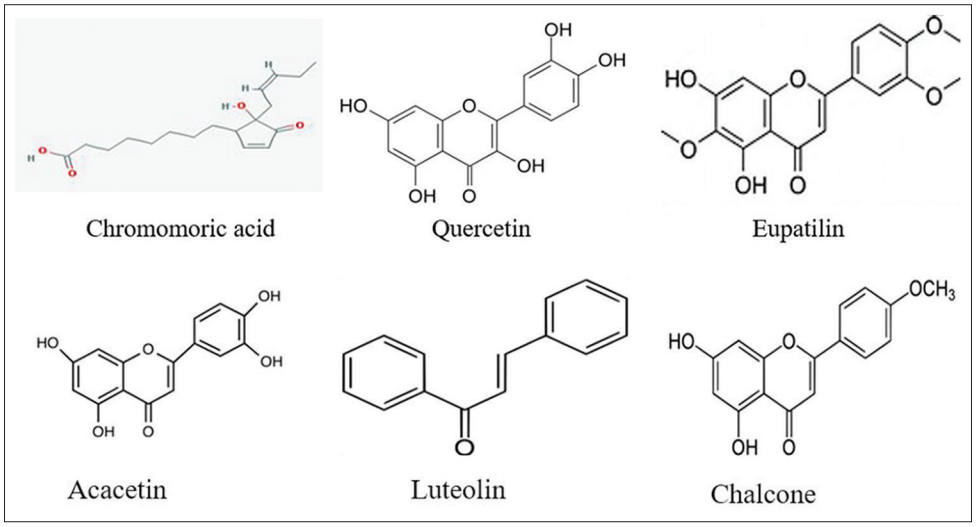

Fig. 2: Various phytoconstituents of *Chromolaena odorata*

The nitric oxide scavenging activity of the *C. odorata* extract was demonstrated by Alisi *et al*., 2008, in which it was quantitatively determined by the total phenolic content which shows that the extract contains an appreciable quantity of the phenolic compounds and these compounds might be responsible for the antioxidant potential of the extract [55].

Cardiovascular effects

The studies conducted by Umukoro *et al*., 2006, on the cardiovascular effects of the *C. odorata* extract exhibited its significant membrane stabilizing activity against hemolysis as well as PAF receptor-binding inhibiting property [51].

Cytoprotective

An experiment conducted by Nurjannah *et al*., 2006, in rats proved their efficacy as an antiulcer agent when used orally [56]. For this research, *C. odorata* extract was given in combination with honey for its use in the treatment of stomach ulcer lacerations. Cytotoxic studies of the *C. odorata* extract were also carried out. These studies demonstrated the presence of number of compounds in the extract such as acacetin (5, 7-dihydroxy-4'-methoxy flavone) and luteolin (5, 7, 3', 4'-tetrahydroxyflavone). These compounds also expressed for their significant activity against human small cell lung cancer and human breast cancer.

Wound healing

The most established and discussed aspect of *Chromolaena* is its role in wound healing. Ayyanar *et al*., 2009, established that extracts from the leaves of *C. odorata* have been shown to be useful for the treatment of wounds. In traditional usage, the leaf is ground into a paste and is applied topically on affected places to heal wounds [57]. Raina *et al*., 2008, showed that the aqueous extract and the decoction from leaves of this plant have been used throughout Vietnam for the treatment of soft tissue wounds and burns for decades. A product named EUPOLIN made from *Chromolaena* has already been licensed for use in Vietnam for soft tissue burns and injuries [58,59].

CONCLUSION

C. odorata is very useful habit for treating various types of diseases. Various studies have demonstrated that *C. odorata* possesses anti-inflammatory, analgesic, antipyretic, antimicrobial, cardiovascular effects, cytoprotective, wound healing, nematicidal, and antimalarial activity. The chemical constituents such as phenolic acids, flavonoids, and other important chemical constituents are responsible for these activities. Review of the literature concluded that *C. odorata* is considered to be a useful herbal medicinal plant.

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AUTHOR'S CONTRIBUTION

We declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. Miss Sana Shaikh collected the data and analyzed the data. Dr. (Mrs.) Vanita Kanase proofread the whole manuscript, and suggested the necessary changes, and helps in designing manuscript.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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