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Sphagneticola trilobata: A Green Treasure of Phytochemical Constituents and Medicinal Values

Divya C.[1,*], D. Visagaperumal[2], Vineeth Chandy[3]

Abstract

Sphagneticola trilobata originally from the Caribbean, Mexico, and Central America, is a plant of the Asteraceae family, tribe Heliantheae, that is now found growing across the Neotropics. The plant profile, key components, chemical test, and pharmacological actions of S. trilobata are all included in this review. The main constituents of the plant were limonene, bicyclogermacrene, α-humulene, α-pinene, α-phellandrene, and germacrene D, camphene, sabinene, 10-nor-calamenen-10-one, and γ-amorphene. It shows pharmacological active effects, such as antioxidant, analgesic, anti-inflammatory, antimicrobial, antibacterial, antifungal, wound healing, larvicidal, trypanocidal, uterine contraction, antitumor, hepatoprotective, cytotoxic, CNS depressant activity and used in the treatment of diabetes, menstrual pain, and reproductive problems in women.

Keywords: *Sphagneticola trilobata*, Asteraceae, phytochemical investigation, pharmacological activities, antibacterial, antioxidant

INTRODUCTION

While nutraceuticals are more recently developed, nutritionally or medicinally enhanced foods with health benefits that are sold in developed nations, herbal medicines are the result of hundreds of years' worth of therapeutic experience accumulated by generations of indigenous medical practitioners. Marketing the former under the latter's title is unethical. Herbal medicines are quite popular for primary healthcare in the developed world because of their low side effects, safety, and effectiveness [1]. They also provide treatments for age-related illnesses that are not currently treated by mainstream medicine, such as immune system problems, memory loss, osteoporosis, etc. India has a pitiful share of the global market because of the export of crude extracts and pharmaceuticals, despite its wealth of traditional knowledge, history of using herbal remedies, and abundant biodiversity. Although about 80% of the world's population receives primary healthcare from traditional medicines, the WHO has not conducted a systematic evaluation of these treatments either. However, in 1991, WHO established guidelines for assessing herbal medicine. Standardization of herbal medicine is suggested [2]. The circumstances and views towards herbal medicine are discussed. The World Health Organization (WHO) defines traditional medicine as "a combination of therapeutic practices that have been around for hundreds of years before modern medicine developed and spread, and are still in use today." This definition includes herbal drugs. In other words, traditional medicine is the result of the therapeutic experiences of generations of indigenous medical professionals. Minerals, medicinal plants, and organic debris are all part of the traditional treatments. Herbal pharmaceuticals are limited to conventional drugs that primarily use combinations of medicinal plants for treatment. They have been used for around 5,000 years in texts

***Author for Correspondence**
Divya C.
E-mail: divya7019910157@gmail.com

[1]Student, Department of Pharmaceutical Chemistry, T. John College of Pharmacy, Gottigere, Bengaluru, Karnataka, India
[2]HOD, Department of Pharmaceutical Chemistry, T. John College of Pharmacy, Gottigere, Bengaluru, Karnataka, India
[3]Principal, T. John College of Pharmacy, Gottigere, Bengaluru, Karnataka, India

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from India, China, Egypt, Greece, Rome, and Syria [3].

Herbal plants are accorded primary importance in traditional medical systems like Ayurveda and Siddha [4]. The usage of herbal remedies is becoming more and more common among people worldwide. Approximately 60% of people on the planet use traditional medicinal plants. Interest in traditional medicine is rapidly growing among the general population, academics, and government due to the growth in pharmacological side effects and the cost of the current medical system [5]. India has a vast collection of medicinal plants used in conventional medicine, and up to 80,000 flowering plants are used as medicines worldwide [6]. Herbal plants are primarily valued in traditional medical systems like Ayurveda and Siddha.

The plant *Sphagneticola trilobata* belongs to the tribe Heliantheae and the family Asteraceae. Wedelia, marigold Singapore daisy, creeping-oxeye, trailing daisy, and bay biscayne creeping-oxeye are other names for it. Although native to the Caribbean, Mexico, and Central America, it is currently seen growing across the Neotropics. It is commonly grown as a decorative groundcover [7]. An extensive review of the literature showed that the main types of phytoconstituents in this plant are tannin, saponins, flavonoids, phenol, and terpenoids. Studies on the pharmacological properties of this plant have shown that it is effective against cancer, diabetes, menstrual discomfort, ovarian issues, wound healing, larvicidal, trypanocidal, uterine contraction, antioxidant, hepatoprotective, and antibacterial. *Sphagneticola trilobata* appears to have a lot of potential for further biological activity research, particularly in relation to its effects on inflammation, bacterial infections, and the reproductive system. Natural products have historically been a major source of therapeutic agents, with plant-derived compounds, such as Taxol and Artemisinin becoming highly effective in treating cancer and malaria, respectively. *Sphagneticola trilobata*, a plant rich in various phytochemicals, holds promise for future drug discovery in areas, such as anticancer, antimicrobial, and antioxidant treatments due to its diverse bioactive compounds [8].

PLANT PROFILE

Sphagneticola trilobata belongs to the family Asteraceae, is Perennial in nature, and reaches a height of 45–60 cm. Round, green stems that root at nodes.

These are 10–30 cm long. The flowering sections of the stems are ascending, coarsely strigose to spreading hirsute, and occasionally subglabrous. Leaves have a medium texture, are fleshy, and are typically 4–9 cm long. Simple obovate, 2–5 cm wide, irregularly toothed or serrated, and typically having two lateral lobes. The arrangement of the leaves is subopposite to opposite [9]. Brochidodrome and bent leaf venation are present. *Sphagneticola trilobata* typically produces flowers all year round. Solitary flowers can develop in the leaf axils at any height, although they seem to be most abundant approximately 10 cm above the ground [10]. Corolla disc 4–5 mm long; a crown of short fimbriate scales called pappus; peduncles that are 3–10 cm long, involucre, campanulate-hemispherical, and 1 cm high; lanceolate, inflexible chaffy bracts with ray florets that are frequently 8–13 per head, yellow in color, and have rays that are 6–15 mm long. The fruit coat of the achenes tuberculate, which is 4–5 mm long, is hard, dry, and brown. It is difficult to notice fruits (Figure 1) (Table 1) [11].

Figure 1. *Sphagneticola trilobata.*

Table 1. Taxonomical classification.

Kingdom	**Plantae**
Class	Dicotyledonae.
Domain	Eukaryota.
Phylum	Spermatophyta.
Subphylum	Angiospermae.
Order	Asterales.
Family	Asteraceae.
Genus	Sphagneticola.
Species	Trilobata.

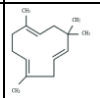
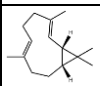
Synonyms

Complaya trilobata, wedelia carnosa, acanthospermum trilobatum, acanthospermum trilobata, and wedelia trilobata.

Phytochemical Constituents of *S.trilobata*

The plant contains Low concentrations of oxygenated sesquiterpenes and a high percentage of hydrocarbon monoterpenes and sesquiterpenes were the defining characteristics of the essential oil. The main constituents of the mixture were limonene (1.8–15.1%), bicyclogermacrene (6.0–17.0%), α-humulene (4.0–11.6%), α-pinene (7.3–23.8%), α-phellandrene (1.4–28.5%), and germacrene D (11.9–35.8%), camphene (0.7–2.0%), sabinene (1.4–1.9%), 10-nor-calamenen-10-one (<0.05–1.5%), γ-amorphene (<0.05–1.3%) (Table 2) [12, 13].

Table 2. Phytochemical constituents.

1.	Germacrene D	
2.	α-phellandrene	
3.	α-pinene	
4.	α-humulene	
5.	Bicyclogermacrene	
6.	Limonene	
7.	Camphene	
8.	Sabinene	
9.	10-nor-calamenen-10-one	

10.	γ-amorphene	

PHYTOCHEMICAL INVESTIGATIONS OF *S. TRILOBATA*

The major secondary metabolites, such as alkaloids, flavonoids, saponins, terpenoids, steroids, glycosides, tannins, quinones, phenolbatannins, and oxalate, were evaluated using the following tests,

- *Test for alkaloids (Wagner's Reagent):* Three to five drops of Wagner's reagent were added to a fraction of the extract, and the formation of a reddish-brown precipitate – a sign of the presence of alkaloids – was monitored.
- *Test for flavonoids (Alkaline Reagent Test):* A small amount of a 20% sodium hydroxide solution was added to two ml of extracts. The presence of flavonoids is indicated by the formation of a bright yellow color that turns colorless when diluted hydrochloric acid is added.
- *Saponins test (Foam Test):* Water was added to the test solution, which was then agitated and watched for the production of foam, which should last for 15 minutes. This suggests that saponins are present.
- *Salkowki's Test:* For terpenoids, it involved adding 1 ml of chloroform to 2 ml of each extract, then adding a few drops of strong sulphuric acid. Terpenoids were promptly detected by the production of a reddish-brown precipitate.
- *The Liebmann Burchard Test:* For steroids, it involved boiling and cooling crude extract with a few drops of acetic anhydride. After that, concentrated sulphuric acid was injected from the test tube's sides, and the junction of two layers was watched for the development of a brown ring. The development of the higher layer's green coloring indicates the presence of steroids.
- *The Keller-Killiani Test:* For glycosides, it involved mixing a solution of ferric chloride with a few drops of glacial acetic acid. After adding concentrated sulphuric acid, the creation of two layers was monitored. A positive test for glycosides would show a lower reddish brown layer and an upper acetic acid layer that turns bluish-green.
- *The Braymer's Test for Tannins:* A fraction of 10% alcoholic ferric chloride solution was applied to 2 ml of extract. Tannins are present when a blue or greenish-colored solution forms. Check for quinones concentrated HCL was applied to a small amount of extract, and the production of a yellow precipitate (or coloration) was monitored.
- *Phlobatannin Test (Precipitate Test):* The presence of phlobatannins was determined by boiling 2 ml of the extract with 1 ml of 1% aqueous hydrochloric acid, which resulted in the deposition of a red precipitate.
- *Test for Oxalate:* To check for oxalate, a few drops of glacial ethanoic acid were added to a 3 ml quantity of extracts. The presence of oxalates is indicated by a greenish-black coloring.
- *Protein Test (Biuret Test):* Two drops of 1% copper sulfate solution and 10% sodium hydroxide solution were added to the test solution, and the production of a violet or pink hue was monitored [14].

PHARMACOLOGICAL ACTIVITIES OF *S. TRILOBATA*

The pharmacological activities of *S.trilobata* are antioxidant, analgesic, anti-inflammatory, antimicrobial, antibacterial, antifungal, wound healing, larvicidal, trypanocidal, uterine contraction, antitumor, hepatoprotective, cytotoxic, CNS depressant activity and used in the treatment of diabetes, menstrual pain, and reproductive problems in women. The antioxidant activity observed in *S. trilobata* suggests potential neuroprotective and anticancer applications, where oxidative stress plays a key role. The plant's antimicrobial properties, particularly its efficacy against *Escherichia coli* and *Salmonella typhi*, indicate its potential in the development of treatments targeting antibiotic-resistant bacterial strains [15].

ANTIOXIDANT ACTIVITY

The extract was dissolved in ml of methanol to create the extract solution at various concentrations (25–200 μg/ml) 4 ml of dissolved extract was combined with 1 ml (0.4 mM). Following a 30-minute

dark incubation period at 37°C, the result was quantified using an ultraviolet-visible spectrophotometer. A total of 4 ml of methanol buffer were mixed with 1 ml of DPPH (0.4 mM) to create a negative blank.

Antioxidant activity (%) = 100% × (blank absorbance–sample absorbance)/blank absorbance) (1)

ANTIBACTERIAL ACTIVITY

After preparing a 100 µl bacterial inoculum (108 CFU/ml) on nutrient broth, the extract and positive standard (5–100 mg/ml) were serially diluted and added to the well. After incubation for 24 hours, the inhibition zone was assessed. We employed ampicillin, tetracycline, clindamycin, ciprofloxacin, ofloxacin, chloramphenicol, and ciprofloxacin as positive controls. As a negative control, dimethyl sulfoxide (DMSO) was employed [16, 17].

ANTICANCER ACTIVITY

In triplicate, Mardina V, et al. evaluated the cytotoxicity of 3-(4,5-dimethylthiazol-2-yl)-2, 5-diphenyl tetrazolium bromide (MTT). MCF-7 cancer cells (5000 cells/100 µl) were incubated overnight after being seeded into plates one at a time and exposed to different quantities of extracts (1, 5, 10, 25, 50, 100, and 200 µg/ml). Ten microlitres of MTT reagent (5 mg/ml) were added to each well for a 4-hour re-incubation. The reaction was halted by adding 10% SDS to 0.1N HCl. The assay's optical density (OD) was measured at 595 nm. The inhibitory rate against viability MCF-7 was calculated using this formula.

$$\%\ cell\ Inhibition = \left(\frac{[A570\ of\ control\ cells - A570\ trated\ cells]}{A\ 570\ of\ control\ cells}\right) \times 10. \quad (2)$$

The extract's cytotoxicity was expressed as LC50, which was determined by interpolating the concentration versus the percentage of cell line death plot [18].

ANTIDIABETIC ACTIVITY

Buddhakala N, et.al. performed oral administration of 250 mg/kg body weight of *S. trilobata* extract was used to test the antidiabetic effect in streptozotocin-induced diabetic rats for eight weeks. Body weight, blood glucose, serum insulin, and lipid profiles were measured during this time [19].

ANTI-INFLAMMATORY ACTIVITY

Fucina G, et.al. conducted studies on the potential of extracts to prevent mice's ear dermatitis caused by Croton oil was assessed The non-steroidal anti-inflammatory drugs (NSAID) indomethacin was utilized as a reference [20].

MECHANISM OF ACTION: FOCUS ON DRUG TARGETS

Compounds, such as germacrene D and α-humulene may exert their pharmacological effects by modulating pathways involved in inflammation, such as the inhibition of pro-inflammatory cytokines. Additionally, these compounds may target specific enzymes responsible for oxidative stress, suggesting a mechanism for their antioxidant and anticancer properties [21].

ANTICANCER AND ANTIMICROBIAL DRUG DISCOVERY

The anticancer activity of *S. trilobata*, particularly its effect on MCF-7 breast cancer cells, could be further explored through structure-activity relationship (SAR) studies. Such studies would help optimize the anticancer efficacy of the plant's bioactive compounds by identifying key functional groups necessary for potent activity. Similarly, its antimicrobial properties could be enhanced by structural modifications to overcome antibiotic resistance.

LEAD OPTIMIZATION AND FUTURE DRUG DEVELOPMENT

Compounds isolated from *S. trilobata* have shown initial promise as lead compounds for drug development, especially in anticancer and antimicrobial therapies. Lead optimization strategies, such as chemical modifications to increase potency and bioavailability or reduce toxicity, could advance these compounds toward clinical use.

CONCLUSIONS

The WHO estimates that over 80% of people on the planet depend on natural goods for their health and low risk of side effects. Numerous research publications were reviewed as part of the literature review process for *S. trilobata.* The specific plant was found to possess a variety of properties, antioxidant, analgesic, anti-inflammatory, antimicrobial, antibacterial, antifungal, wound healing, larvicidal, trypanocidal, uterine contraction, antitumor, hepatoprotective, cytotoxic, CNS depressant activity and used in the treatment of diabetes, menstrual pain and reproductive problems in women. *Sphagneticola trilobata* has been the subject of relatively few studies, yet despite this, there is still much to learn about the many purposes of this plant.

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