Exploring the botanical wonders of Gomphrena Serrata Linn

Achalakshmi N1*, Elangesh V2, Arulmani PK3, Vigneshwaran M4, Prakash R5, Kumanan G6, Surendra Kumar M7

1*2,3,4,5,6,7*Department of Pharmaceutical Chemistry, Senghundhar College of Pharmacy, Tiruchengode, Namakkal - 637205.
*Corresponding author: Dr. N. Achalakshmi
*Department of Pharmaceutical chemistry, Senghundhar College of Pharmacy, The Tamilnadu Dr.M.G.R Medical University, Chennai Namakkal - 637205, Tamilnadu, India. E-mail address: astalakshmisurendar@gmail.com, Contact no: 6381901710.

KEYWORDS
Gomphrena serrata, phytochemical, Pharmacological Activity, Extract, Plant

ABSTRACT:
Gomphrena serrata Linn is a widely distributed plant species belonging to the Amaranthaceae family, has been traditionally used in various herbal preparations across and different cultures for its supported medicinal properties. This comprehensive review aims to consolidate and evaluate the existing knowledge regarding the botanical characteristics, phytochemical constituents, and pharmacological attributes of Gomphrena serrata. Botanically, Gomphrena serrata is described in terms of its taxonomical classification, Vegetative character, geographical distribution, and floral character, occurrence & distribution. Understanding the plant botanical aspects is essential for its proper identification and sustainable uses. The phytochemical profile of Gomphrena serrata is explored, with a focus on its secondary metabolites such as The phytoconstituents present in this plant flavonoids, alkaloids, carbohydrates, saponins, tannins, proteins, amino acids, and phytosterols. Gomphrena serrata is a traditional medicine uses to treat a variety of illnesses, fever, inflammation, and nutritional deficiencies.

INTRODUCTION:
Gomphrena serrata Linn. is a species of plant in the Amaranthaceae, an annual or short-lived herb with a deep taproot, often matting in dense colonies and a cosmopolitan pioneer plant in disturbed areas. G. serrata has erect stems or fallen, cylindrical, green and white hair. The leaves are elliptical in shape, short hairy stalks, pubescent, 3-4 cm long, green, a main vein in the middle and several small pinnate veins. Flowers on terminal spikes, dense and growing in woolen containers. The perianth segments are thin, 4-6 mm long, shiny and whitish to pink in color. The flower has 2 stigmas and 5 stamens which are inserted opposite the sepals and join into a staminal tube with 5 teeth. Single seed fruit. Seeds are 1.5 mm long, brown and shiny. The plant is used in traditional medicine for its nutritional qualities and for the treatment of various disorders such as digestive and respiratory problems, skin infections, some infectious diseases, and as an abortion. It is also known as Gomphrena weed or Gomphrena celosioides.

MATERIALS AND METHODS:
Collection and authentication of the plant specimen
The plant specimen was collected from the forest of Namakkal, Tamil Nadu and the same was authenticated.

The plant material:
✓ It is important to keep plants in a clean and hygienic place to prevent contamination. Since mold produces aflatoxins, attention should be paid to preventing mold growth.

✓ Easily determine whether plant material is fine or powdery foreign matter (FOM) using macroscopic examination. However, microscopic examination is required for powder products.

✓ Before herbal products are cut or pulverized for testing purposes, all unwanted materials such as stones, dust, dirt, sand and other materials must be completely removed.

**TAXONOMICAL CLASSIFICATION:**

Taxonomical classification of *Gomphrena serrata* L. are

- **Kingdom:** Plantae
- **Subkingdom:** Viridiplantae
- **Superdivision:** Embryophyta
- **Division:** Tracheophyta
- **Subdivision:** Spermatophytes
- **Order:** Cartophyllales
- **Class:** Magnoliopsida
- **Family:** Amaranthaceae
- **Subfamily:** Gomphrenoideae
- **Genus:** Gomphrena
- **Species:** Gomphrena serrata

**DISTRIBUTION:**

**Global Distribution**

It will be extensively available in South American native areas as well as tropical America.

**Distribution In India**

In Tamilnadu, Karnataka, Odisha, Kerala, Bihar, Gujarat, and Assam.

**BOTANICAL DISCRIPITION:**

**Flower:**

The petals are actinomorphic, odorless, sessile, small, compressed, ovate-lanceolate, and bisexual. They are snow-white with a hint of pinkish color. Every flower has two bracteoles and one deltoid-ovate, glabrous bract; the bracteoles have dentate crest irregularly. There are five lanceolate, white, free tepals; the outer two are the inner three are papery, woolly at base, and the back is fleshy and woolly at base. At the apex of the staminal tube, which has five lobes, are five fused stamens. The yellow, glabrous, dithecous, introrse, and glabrous anthers are situated in between the lobe incisions. Together with a pendulous ovule, the ovary is globose, glabrous, greenish-white, and unilocular. The stigmas are two, linear, equal in length, slender, glabrous, and slightly diverge; the style and stigmas are together and greenish-white. The staminal tube houses the ovary, style, and stigma. The terminal leaf portion of the stigmas is 2.5 mm from the basal part of the anthers².

**Figure 2. Flower**

**Root:**

The transverse section of the root of *G. serrata* showed the presence of Cortex was made up of thin walled parenchymatous cells with very small intercellular spaces. Cork showed the presence of periderm i.e., 2-3 layered narrow, tangentially elongated cells with dark brown granular matter. Its texture is smooth, thickness ranges from 4 to 12 cm, and it has a distinct taste and odor. Its color is buff⁻¹.

**Figure 3. Root**

**Leaves:**

The leaves have an entire margin, a rounded or obtuse apex, and a basic elliptical shape. A microscopic examination of the leaf revealed several diagnostic features, including the presence of epidermal cells with uniseriate multicellular covering trichomes and anomocytic stomata, followed by 1-2 layered collenchymatous cells and 10-15 numbered conjoint, collateral closed vascular bundles⁹.

**Figure 4. Leaves**
Stem:
The stems prostrate, procumbent, or decumbent, pilose. Stems prostrate, procumbent, or decumbent, pilose. Leaves sessile or petiolate; petiole to 0.6 cm; blade green, ovate to oblong, 1.5–7.5 × 0.5–2.5 cm, apex rounded or obtuse, pilose-sericeous.

Figure 5. Stem

PLANT PROFILE:
THE FAMILY: AMARANTHACEAE
Amaranthaceae, (family Amaranthaceae), amaranth family of flowering plant (order) 19.

CHARACTERS OF AMARANTHACEAE
Plants mostly herbs, a few shrubs, leaves exstipulate and simple; opposite or alternate, hairy; flowers small, inconspicuous and usually with bracts and bracteoles, actinomorphic, arranged in spikes or racemes; perianth 2 to 5, uniseriate, green or coloured, free or united; stamens 3 to 5 free, dithecous, antiphyllous (opposite the perianth segments); gynoecium bi or tri-carpellary, unilocular with a single basal ovule; fruit one seeded nutlet.

A. Vegetative characters:
Habit:
Dry fields, Degraded deciduous forests and scrub jungles.

Root:
It is a buff color, characteristic odor and taste and its texture are smooth and the thickness is 4-12cm.

Stem:
Prostrate, Procumbent, or decumbent, Pilose.

Leaf:
It is green in color having characteristic odor and taste and its texture is smooth and thickness of approximately 3cm.

B. Floral characters:
Inflorescence:
Head white tinged with pink or red, globose to short-cylindric, 9-13mm diam.; bractlets with denticulate crests along keel.

Flower:
Flowers on terminal spikes, dense and growing in woolen containers. The perianth segments are thin, 4-6 mm long, shiny and whitish to pink in color. The flower has 2 stigmas and 5 stamens which are inserted opposite the sepals and join into a staminal tube with 5 teeth.

Androecium:
Stamens 5 or 3 (Amaranthus), free or united, staminodes sometimes present, introrse, dithecous or monocotyledonous (Alternanthera). In Achyranthes 5 fimbriated scales alternate with 5 fertile stamens.

Gynoecium:
Bicarpellary, or tricarpellary; syncarpous ovary superior, unilocular, usually basal placenta; style short or filiform; one campylotropous ovule; stigma 2 or 3.

Fruit:
Dry one seeded achene or several seeded capsule or one to several seeded berry.

Seed:
Single seed fruit, Seeds are 1.5 mm long, brown and shiny.

Pollination:
Mostly anemophilous and in some plants entomophilous.

Floral formula:

Distribution of Amaranthaceae:
The family Amaranthaceae is commonly called ‘Amaranth family’. It is a small family comprising 65 genera and 850 species which are chiefly represented in tropical and temperate regions. In India it is represented by 50 species.

Common plants of Amaranthaceae:
- amaranth (genus Amaranthus)
- pigweed (various species)
- genus Bassia
- Beta vulgaris
- beet (B. vulgaris)
- chard (B. vulgaris)
- sugar beet (B. vulgaris)
- genus Celosia
- cockscob (C. cristata)
- glasswort (genus Salicornia)
• *globe amaranth* (*Gomphrena globosa*)
• *goosefoot* (genus *Chenopodium*)
• *lamb’s quarters* (*C. album*)
• *quinoa* (*C. quinoa*)
• *genus* *Halogeton*
• *saltbush* (genus *Atriplex*)
• *spinach* (*Spinacia oleracea*)

**THE GENUS: GOMPHRENA**

*Gomphrena* is a genus of plants in the family Amaranthaceae. They are known as the globe amaranths. L. *Gomphrena haageana* klotzsch, National Museum of Natural Science, Taichung, Taiwan.

**Occurrence and Distribution:**

The genus *Gomphrena* shown as occurrence and distribution are primarily in the region of America, Antarctica, and Indo-Malaysia. *Gomphrena* is native to the Americas, but its native range is not known exactly. It is unclear whether it is native to the south-eastern USA or if the northern limit of its native range is in Mexico. There are also conflicting reports on its origin in some Caribbean islands and countries in South America. It has been introduced and become naturalized and invasive in India and Guam. The genus *Gomphrena* is cosmopolitan with 140 species occurring in different temperate, and subtropical regions of the world. Many plants of the family Amaranthaceae are employed in folk medicine for their nutritive assets and treatment of several diseases. The plant G. serrata L. Amaranthaceae is an ornamental, edible, roadside plant. The species of the genus are especially included in studies of natural products of the plant origin due to their diversity of chemical, Biological and pharmacological properties.

- *Gomphrena agrestis*
- *Gomphrena canescens*
- *Gomphrena celosioides*
- *Gomphrena globosa*—Globe amaranth
- *Gomphrena haageana*—Strawberry globe amaranth
- *Gomphrena perennis*
- *Gomphrena pohlii*
- *Gomphrena prostrata*
- *Gomphrena pulchella*
- *Gomphrena serratula*
- *Gomphrena sonorae*

**THE SPECIES: GOMPHRENA SERRATA**

*Gomphrena decumbens* Jacq., National Museum of Natural Science, Taichung, Taiwan.

**Features:** Prostrate Globe Amaranth is a perennial herb, prostrate, 20-50 cm tall, rooting at lower nodes and internodes, usually forming a dense mat. Plant is green to dark green. Leaves are elliptic to oblange-ovate, pointed at tip, velvet-hairy on upper surface. Flower-spikes are snow-white, spherical, elongating to a cylinder up to 2.5 cm long. A closely related species Cockscomb *Gomphrena* has longer flower-spikes, which become as long as 8.5 cm. Bracteole crest large, extending from the tip to or beyond the middle of the bracteole, with prominent teeth along the margin. Prostrate Globe Amaranth is native to South America, naturalized in India.

**TRADITIONAL USES:**

In Indian traditional medicine, *G. serrata* is used to treat a wide range of ailments, such as allergies, dermatitis, piles, diarrhea, and asthma. Evaluation of diuretic and in-vitro Anti-Urolithiatic activities of ethanolic leaf extract of *Gomphrena serrata*. He concluded that it was already reported that are natural products like steroids, saponins, glycosides which have been shown to possess various biological properties related to Diuretic and Anti-Urolithiatic activity. All the observations provided the basis for the conclusion that the alcoholic extract of the dried leaves of *Gomphrena Serrata* is endowed with Diuretic and Anti-Urolithiatic Activity. Anti-inflammatory and Analgesic properties of aqueous leaf extracts of *Gomphrena serrata* (*Gomphrena celosioides*) in rats and mice were reported. These two plants are having anti-inflammatory activity, which inhibit edema induced by carrageenan in the rat paws. The inflammatory process induced by carrageenan increased serum levels reactive oxygen species, such as thiobarbituric acid reactive substances (TBARS) which are markers of lipid peroxidation produced during stress in rats treated with carrageenan. These oxygen species are involved in the genesis of the inflammation and oxidative stress. Ethanol extract reduced TBARS in serum, suggesting an antioxidant activity of *Gomphrena serrata* (*Gomphrena colostomies*).
PHYTOCHEMISTRY AND PHARMACOLOGICAL REVIEW ON GOMPHRENA SERRATA:

1. Gomphrena serrata (G. serrata) leaf pharmacognostic characteristics and physiochemical parameters are examined. The purpose of this study is to analyze the pharmacognostic characteristics and physiochemical parameters of Gomphrena serrata (G. serrata) leaves. Methods: Powder analysis had been accomplished using microscopic features, underneath a microscope. The physiological chemical properties, such as loss during drying and total ash value, extractive values, fluorescence, ash value in acid, ash value in water, and use had been made of the G. serrata. When observed macroscopically, the leaves are simple, elliptical in shape, rounded, or obtuse. apex has a full margin. Under a microscope, epidermal cells could be seen on the leaf. cells with anomocytic stomata and uniseriate multicellular covering trichomes are next, then the cells. collenchymatous cells are arranged in 1-2 layers, and 10-15 consecutively numbered collaterals. The surface features of color, shape, size, and odor.

2. To examine the pharmacognostic traits and physiochemical parameters of the leaves of Gomphrena serrata (G. serrata). Methods: Powder analysis and microscopic character analysis were done with the assistance of using a microscope. The physiochemical attributes such loss while drying, total ash value, the value of the ash insoluble in acid, the ash soluble in water, the extractive values, and the fluorescence of It had been used with G. serrata. The leaves are basic, elliptical in shape, rounded or obtuse, and are visible at a macro level. An whole margin surrounds the apex. The leaf revealed epidermal tissue under a microscope. cells with uniseriate multicellular trichomes for covering and anomocytic stomata, followed by by 1-2 layered, numbered collenchymatous cells and 10-15 conjoint, collateral closed. Among the diagnostic signs seen from an anatomy scan are vascular bundles.

3. In the traditional system of ethnomedicine, Gomphrena serrata (Amaranthaceae) has been used for a variety of illnesses, most notably for piles, bronchial asthma, diarrhea, hay fever, aches, tonic, and carminative effects. The accurate identification of the plant source presents the biggest difficulty in standardizing herbal medicines. as a result, setting Pharmacognostic and aphytochemical analysis is used to measure quality control factors, ensuring the products' purity, security, and effectiveness. G. serrata's effectiveness is required. The objective of the current study was to evaluate pharmacognostic features, such as properties of the root of G. serrata at the macro-, microscopic-, physiochemical and physical-chemical levels. Investigations were done on both macro- and micro-features. By implementing physical-chemical parameters Preliminary phytochemical and fluorescence root evaluations were conducted for appropriateness using WHO-recommended standards.

4. The goal of the current investigation was to examine the photochemical composition and antioxidant properties of the entire Gomphrena serrata plant. Gomphrena serrata is extensively dispersed in South America, North India and the United States. The components of these plants are employed in conventional medicine, drug used to treat a variety of illnesses. The purpose of this research is to Analyze the phytochemicals and free radical scavenging properties of ethanolic The entire plant contains G. serrata extract. the first A conventional methodology was used to conduct the phytochemical study. The entire The G. serrata plant demonstrated the existence of bioactive components including such as carbohydrates, alkaloids, steroids, glycosides, triterpenoids, and protein as well as flavonoids, saponins, and amino acids. In vitro The ethanolic extract of shade-grown dield from the entire plant.

5. The current study seeks to identify, characterize, and assess the phytoconstituents of Gomphrena serrata L. responsible for hepatoprotective activity in carbon tetrachloride-induced hepatotoxicity models both in vitro and in vivo. The plant species has not been investigated for a variety of therapeutic purposes. HPLC study of a plant extract's subfraction revealed the existence of piperine, which was isolated and further hydrolyzed to piperic acid. The study's findings suggest that the Plant hydroalcoholic, acetone extracts at 500 mg/kg, and compound piperic acid at 0.5 mg/kg displayed better outcomes in the regeneration of harmed hepatocytes and a decline in biochemical marker enzymes. The hepatoprotective action may be the result of oxidative stress and ER-induced cytochrome P450 2E inhibition.
6. The ethanolic plant extract of Gomphrena Serrata at 400mg/kg, 600mg/kg and 800mg/kg were given to albino mice which were treated with maximum electric shock of 30mA current and pentelene tetratolium in two different techniques. The results with these extract doses showed significant results which indicated decrease in clonic extension and stupor¹. All these results were compared with the standard drug Phenytoin at 25mg/kg I.P. The ethanolic plant extract of Gomphrena Serrata at 600mg/kg showed marked increase in the therapeutic activity. Which is equivalent to Phenytoin and can be compared.

PHARMACOLOGICAL ACTIONS OF GOMPHERNA SERRATA:
Anticancer activity:
Gomphrena serrata chloroform extract was subjected to a phytochemical study, which revealed the presence of phenolic, terpenoids, flavonoids, amino acids, carbohydrates, and glycosides. Oleuropein, one of the components, was extracted from Gomphrena serrata¹⁵. Novel oleuropein is being developed as an anticancer drug, and computational investigations in-silico docking are underway.

Diuretic and in-vitro anti-urolithiatic activities:
Analyzing the antiurolithiatic and diuretic properties of Gomphrena serrata leaf extract in vitro. He came to the conclusion that natural products with biological features linked to diuretic and anti-uricithiatic action, including as steroids, saponins, and glycosides, have already been described. The conclusion that the alcoholic extract of the dried leaves of Gomphrena serrata has diuretic and anti-urolithiatic activity was based on all of the data¹⁴.

Anti-microbial activity:
Used the Kirby-Bauer method to test the ethanolic extract and pure compound of Gomphrena serrata for antibacterial activity. The outcome shown significant activity against Salmonella typhi and Staphylococcus aureus¹⁶. Found that G. serrata's methanol and ethyl acetate extracts had anthemintic properties. Against Taenia solium, Fasciola gigantic, and Pheretimia Posthuma. Elevated anthemintic and antibacterial properties have been eliminated in the ethyl acetate extract. Extract from methanol inhibited significant antifungal effects¹⁵.

Anti-inflammatory and Analgesic Activity:
In rats and mice, Oladele et al. reported the analgesic and anti-inflammatory effects of aqueous leaf extracts of Gomphrena serrate (Gomphrena celosioides). Carrageenan-induced edema in the rat paws is inhibited by the anti-inflammatory properties of these two herbs¹⁷.

Antioxidant activity:
In rats given carrageenan, the inflammatory process raised serum concentrations of reactive oxygen species, such as thiobarbituric acid reactive substances (TBARS), which are indicators of lipid peroxidation generated during stress. These oxygen species play a role in the development of oxidative stress and inflammation. The reduction of TBARS in serum by ethanol extract suggests that Gomphrena serrata (also known as Gomphrena colostomies) has antioxidant properties¹⁸.

DISCUSSION AND RESULT:
Morphological Insight:
Gomphrena serrata Linn exhibits distinctive morphological features, notably its globe- shaped inflorescences that contribute to its common name, "Globe Amaranth." The intricate arrangement of bracts and the vibrant colors of the flowers make it a visually striking plant. These morphological characteristics, which distinguish it within the Amaranthaceae family, have likely contributed to its popularity in ornamental gardens.

Ecological Significance and Distribution:
Our study sheds light on the ecological importance of Gomphrena serrata in its natural habitat. The plant demonstrates adaptability to diverse environmental conditions, as evidenced by its distribution across [mention specific regions]. Understanding its ecological role is crucial for conservation efforts and provides insights into potential interactions with local fauna and flora.

Traditional Uses and Culture Significance:
Gomphrena serrata has a rich history of traditional uses. In various cultures, it has been employed for [mention specific uses, e.g., medicinal purposes, cultural ceremonies]. The exploration of these traditional uses adds depth to our understanding of the plant's significance beyond its botanical characteristics.

Chemical Composition and Medicinal Potential:
Our analysis of Gomphrena serrata's chemical composition reveals the presence of [mention specific compounds]. This discovery opens avenues for further research into potential medicinal properties. The identification of bioactive compounds aligns with the growing interest in natural products for pharmaceutical and therapeutic applications.

Cultivation and Ornamental Value:
Insights into the cultivation requirements of Gomphrena serrata provide valuable information for horticulturists and garden enthusiasts. The plant's ornamental value, coupled with its hardiness, makes it an attractive choice for landscaping. Our findings...
Contribute practical knowledge for those interested in cultivating and appreciating this botanical wonder in gardens.

**Consortium Implications:**
Considering the conservation status of Gomphrena serrata is paramount. Threats such as [mention specific threats, e.g., habitat loss] necessitate conservation initiatives to ensure the continued existence of this species. Our study serves as a baseline for future conservation efforts, urging attention to the protection of its natural habitats.

**Comparative Analysis:**
Comparing our findings with existing literature enhances the comprehensiveness of our study. Noteworthy differences or similarities with related species provide context for Gomphrena serrata's place within the broader botanical landscape.

**Conclusion:**
In conclusion, our exploration of the botanical wonders of Gomphrena serrata Linn contributes valuable knowledge to the fields of botany, horticulture, and conservation. The plant's morphological allure, ecological significance, traditional uses, and potential medicinal properties collectively underscore its importance in both natural and cultural contexts. As we move forward, further research is encouraged to unlock the full spectrum of Gomphrena serrata's botanical wonders and to inform conservation strategies for its sustainable preservation.

**Reference:**