

Extraction and Preliminary Phytochemical Screening of *Gomphrena globosa* (L.)

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Abstract

Alzheimer's disease (AD) is a progressive neurodegenerative disorder characterized by memory loss, cognitive decline, and impaired daily functioning. The present study evaluated the phytochemical profile and potential anti-Alzheimer activity of the ethanolic flower extract of *Gomphrena globosa* (L.). Fresh flowers were collected from K.R. Market, Bengaluru, authenticated, shade-dried, powdered, and extracted using ethanol by Soxhlet extraction. The obtained extract was subjected to preliminary phytochemical investigation to identify major classes of bioactive constituents. The ethanolic extract showed the presence of carbohydrates, flavonoids, proteins, tannins, saponins, and triterpenoids/steroids, whereas alkaloids were absent. Among the identified phytoconstituents, flavonoids showed a comparatively stronger positive response. *Gomphrena globosa* has been reported to contain bioactive flavonoids such as quercetin, kaempferol, isorhamnetin derivatives, and chrysoeriol-7-O- β -D-glucoside, along with betalains, steroids, and triterpenoids. These constituents may contribute to antioxidant, anti-inflammatory, and neuroprotective effects relevant to Alzheimer's disease. The present phytochemical findings provide preliminary evidence supporting further investigation of *G. globosa* as a potential source of neuroprotective agents. Further behavioural, biochemical, histopathological, and molecular studies are required to confirm its anti-Alzheimer efficacy and mechanisms of action.

Keywords: *Gomphrena globosa*, Alzheimer's disease, ethanolic extract, flavonoids, phytochemical screening, neuroprotection.

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1.Introduction

Alzheimer's disease (AD) stands out as a prominent neurodegenerative condition marked by progressive cognitive decline and the inability to perform daily activities independently.^[1] Alzheimer's disease (AD) is a progressive neurodegenerative disorder characterized by memory loss, cognitive decline, and impaired daily functioning. As the disease progresses, patients experience difficulties with communication, decision-making, recognition, and independent activities. AD may also cause behavioural and personality changes, resulting in significant emotional and social burden for patients and their caregivers.^[2] According to current data, the annual incidence of AD is projected to rise to one million cases by 2050, resulting in an estimated total prevalence of 11 to 16 million affected individuals.^[3] Alzheimer's disease (AD) is predominantly an age-related condition, and its global prevalence has risen significantly from 1990 to 2019, driven by the aging population and various contributing factors.^[4] The urgent need for effective treatment of Alzheimer's disease arises from the lack of a definitive cure or proven preventive measures, despite significant progress in understanding its pathology. Around 47 million people worldwide suffer from dementia at present, and by 2050, that figure is expected to rise to about 131 million.^[5,6,7] Alzheimer's disease (AD)

is characterized by pathological changes that may begin decades before the onset of noticeable symptoms. Major pathological features include the accumulation of amyloid-beta (A β) plaques, tau protein tangles, and progressive neuronal loss. Several hypotheses have been proposed to explain AD pathophysiology, including the cholinergic, oxidative stress, amyloid cascade, and tau hyperphosphorylation hypotheses. The formation of senile plaques (SP), particularly in the hippocampus, is an important pathological feature of AD. Senile plaques are mainly associated with amyloid-beta (A β) accumulation, while neurofibrillary tangles (NFTs) are composed primarily of hyperphosphorylated tau protein. These pathological changes contribute to neuronal dysfunction, degeneration, and cognitive decline in AD.^[8,9] Several hypotheses have been proposed to explain the pathophysiology of Alzheimer's disease (AD). The cholinergic hypothesis suggests that degeneration of basal forebrain cholinergic neurons reduces acetylcholine levels, leading to impaired learning, memory, and attention^[10,11]. The amyloid-beta hypothesis proposes that abnormal processing of amyloid precursor protein (APP) results in A β accumulation, neuronal damage, and cognitive decline^[12,13]. Neuroinflammation involves chronic

activation of microglia and astrocytes and the release of inflammatory mediators such as IL-1, IL-6, TNF- α , and IFN- γ , contributing to neuronal injury [14,15,16]. The tau hypothesis attributes neurodegeneration to abnormal tau hyperphosphorylation and aggregation, which disrupts microtubule stability and neuronal function [17]. Oxidative stress and mitochondrial dysfunction increase reactive oxygen species (ROS), causing damage to neuronal lipids, proteins, and DNA and promoting A β and tau pathology [18,19,20]. The metal ion hypothesis suggests that disturbances in metals such as copper, iron, zinc, manganese, and aluminium may promote oxidative damage and contribute to AD progression [21].

Gomphrena globosa (L.), commonly known as globe amaranth, is a medicinal plant traditionally recognized for its antioxidant, anti-inflammatory, and neuroprotective properties. Its flavonoids, phenolic compounds, and betacyanin's may help combat oxidative stress associated with Alzheimer's disease. The plant represents a promising but relatively unexplored source of natural neuroprotective agents. This study scientifically evaluates its anti-Alzheimer's potential using a scopolamine-induced rat model. The research bridges traditional medicinal knowledge with modern neuropharmacological approaches. Phytochemical studies of *Gomphrena globosa* have identified diverse bioactive compounds, including phenolic acids, flavonoids, betalains, steroids, and triterpenoids. Major flavonoids include kaempferol, quercetin, isorhamnetin derivatives, and chrysoeriol-7-O- β -D-glucoside. Preliminary screening revealed saponins, alkaloids, tannins, coumarins, steroids, triterpenoids, and essential oils. Betalain pigments such as isogomphrenin II, isogomphrenin III, betanin, gomphrenin, amaranthin, and bougainvillein have also been reported. Triterpenoids including friedelin and epifriedelinol, along with steroidal compounds such as stigmaterol derivatives, have been isolated. These diverse phytoconstituents may contribute to the antioxidant, anti-inflammatory, and neuroprotective activities of *Gomphrena globosa*. [22]

2. Materials and Methods

2.1 Collection and Authentication of Plant Material

Fresh flowers of *Gomphrena globosa* L. (Family: Amaranthaceae) were collected from Krishna Rajendra (K.R.) Market, Bengaluru, Karnataka, India. The plant material was authenticated by Dr. Noorunnisa Begum, Foundation for Revitalization of Local Health Traditions (FRLHT), Bengaluru, India. A voucher specimen (Authentication No. 6898) was deposited in the institutional herbarium for future reference.

2.2 Extraction process

The crude plant extract was prepared by using the Soxhlet extraction method. About 20 g of powdered plant material was accurately weighed and packed uniformly into a Soxhlet thimble. The packed

thimble was placed in the Soxhlet apparatus and extracted with 250 mL of ethanol as the solvent. The extraction process was continued for approximately 24 hours or until the solvent in the siphon tube became colourless, indicating complete extraction. After completion of extraction, the obtained extract was collected in a beaker and concentrated by heating at 30–40°C until the solvent was completely evaporated. The dried extract was stored properly and used for further phytochemical analysis and experimental studies. [23]

2.3 Qualitative Phytochemical Analysis:

Phytochemical tests will be carried out to find the presence of various phytoconstituents viz. The ethanolic extract was found to contain the very best range such as carbohydrates, triterpenoids, proteins, alkaloids, tannins, saponins, and flavonoids.

Table 1: Phytochemical Analysis

Phytochemicals	Test Description	Observation
Carbohydrates	1. Molisch's test: Add 2 drops of α -naphthol to 2 mL of carbohydrate solution. Carefully add concentrated H_2SO_4 along the sides of the test tube.	A violet or purple ring at the junction of the two layer indicates the presence of carbohydrates.

	2. Benedict's test: Add 2 mL of Benedict's reagent to 2 mL of sugar solution. Heat in a boiling water bath for 2–5 minutes	Green: low amount of reducing sugar Yellow/Orange: moderate brick red precipitate: high concentration of reducing sugars
Triterpenoids And Steroids	Liebermann–Burchard Test: Dissolve the extract in chloroform, add 1–2 mL of acetic anhydride+. Carefully add 1–2 drops of concentrated sulfuric acid along the side of the test tube.	A reddish-pink, purple, blue-green, or green color at the junction of the two layers indicates the presence of triterpenoids (or steroids).

Proteins	Biuret Test: Add 2 mL of sample solution + 1 mL of 5% NaOH + add 2–3 drops of 1% CuSO ₄ solution.	The appearance of a violet or purple color indicates the presence of proteins.
Alkaloids	2 ml of extract + 2 ml HCl → boil and cool → add 2 drops of Wagner's reagent	Brownish red coloration indicated the presence of an alkaloid
Tannins	2 ml extract + 2 ml water + 2–3 drops of Ferric chloride (5%)	Green precipitate indicated the presence of tannin
Saponins	2 ml extract → evaporated to dryness →	Persistent foam (1 cm in the

	Residue + 1 ml water → shaken vigorously	test tube) confirmed the presence of saponin
Flavonoids	3 ml extract → evaporated to dryness → Residue + 1–2 ml 50% CH ₃ CH ₂ OH + heat + Mg ribbon + 4–5 drops HCl	Red or orange color indicated the presence of flavonoids.

3 Result

3.1 Extraction of *Gomphrena globosa* (L) flower

The flowers were washed thoroughly under running tap water twice, followed by distilled water to remove contaminants and pollutants. Flowers were shade-dried for 15 days after washing. The dried flowers were powdered using an electrical grinder, sieved and stored in an air tight container for further use.



Figure No 1: Extraction Process

3.2 Preliminary Phytochemical Analysis of *Gomphrena globosa* Flowers

Preliminary phytochemical screening is carried out to identify the major groups of bioactive compounds present in the plant extract. The ethanolic extract of *Gomphrena globosa* flowers showed the presence of several important phytoconstituents, which may contribute to its pharmacological activities. The results are presented in [Table 5].

Table 5: Phytochemical analysis

Sl. No	Phytochemical	Result
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01	Carbohydrates	+
02	Flavonoids	++
03	Protein	+
04	Alkaloids	–
05	Tannins	+
06	Saponins	+
07	Triterpenoids and Steroids	+

Flavonoids such as quercetin in *Gomphrena globosa* flowers may support anti-Alzheimer activity through antioxidant, anti-inflammatory, AChE-inhibitory, and neuroprotective effects.

Discussion

The ethanolic flower extract of *Gomphrena globosa* demonstrated several important phytochemical constituents, particularly flavonoids, along with tannins, saponins, proteins, carbohydrates, and triterpenoids/steroids. The presence of flavonoids such as quercetin may contribute to antioxidant, anti-inflammatory, and neuroprotective effects. These findings support further investigation of its potential anti-Alzheimer activity.

Conclusion

The ethanolic flower extract of *Gomphrena globosa* contains diverse phytoconstituents, with flavonoids showing a prominent presence. These constituents may contribute to its potential neuroprotective and anti-Alzheimer properties. The findings provide a preliminary basis for further pharmacological evaluation using behavioural, biochemical, histopathological, and molecular studies to establish efficacy and mechanisms.

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