



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Review Article

Multifaceted Insights into *Bougainvillea Glabra* Choisy from Morphology to Medicine

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ARTICLE INFO

Published: 01 Aug 2025

Keywords:

Bougainvillea glabra, gallic acid, pharmacological actions, Quercetin.

DOI:

10.5281/zenodo.16679848

ABSTRACT

Bougainvillea glabra belonging to Nyctaginaceae family includes the widely grown ornamental plant, which is becoming more well-known for its many therapeutic uses. Flavonoids, phenolics, alkaloids, terpenoids, and glycosides are among the plant's many bioactive components, which have long been used to treat inflammatory, gastrointestinal, and respiratory conditions by means of modern phytochemical studies using methods like GC-MS, HPLC, and UHPLC-MS, multiple compounds have been identified as contributing to its pharmacological actions, such as quercetin, gallic acid, rutin, and squalene. They have antibacterial, anti-inflammatory, anti-cancer, hepatoprotective, analgesic, and antioxidant qualities. An acute oral toxicity study carried out in accordance with OECD guideline 425 confirmed the extract's safety at dosages up to 2000 mg/kg in rats, indicating a wide margin of safety for something therapeutic use. Furthermore, because of its ability to withstand pollutants, the plant is essential to environmental sustainability. This review provides in depth review on *B. glabra*'s taxonomy, traditional uses, phytochemistry, pharmacological effects, toxicological data, and ecological significance, this review emphasizes the plant's potential as a safe, multi-target therapeutic agent.

INTRODUCTION

Bougainvillea glabra belongs to the Nyctaginaceae family and the genus *Bougainvillea*. They are commonly referred as bougainvillea, four o'clock flower, and paper

flower because of the thin, papery feel of their bracts [1,2]. *Bougainvillea* is a genus of flowering plants that originated in South America. It is a group of thorny vines, bushes, and trees that bloom and are very popular around the world because of their brightly coloured bracts, which are

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



sometimes mistaken for flowers. The bracts on this plant come in many colours, including pink, purple, red, orange, white, and yellow [3].

There are now 18 species of this plant recognized by the WFO Plant List. There are also three hybrids and around 100 varieties *Bougainvillea* is a popular ornamental plant in many parts of Thailand due its colourful bracts [1]. *Bougainvillea glabra* Choisy is a shrub that grows up and has spiky stems. Usually, it grows to be 10 to 12 feet (3.0 to 3.7 meters) tall, but it can sometimes grow to be as tall as 30 feet (9 meters). The name "paper flower" comes from the fact that the small flowers typically bloom in groups surrounded by bright, papery bracts. The leaves are dark green and not symmetrical. They can grow up to 4 inches (10 cm) long. The flowers are about 0.4 cm wide [4].

It's used traditionally for various medicinal purposes such as insecticidal, anti-inflammatory, anti-diarrhoeal, anti-ulcer, anti-microbial, anti-hyperglycaemic agent, antioxidant, antibacterial, antifertility properties and used treat cough and sore throat [2,5].

This article explores the medicinal potential of *Bougainvillea glabra* providing comprehensive insights into botanical characteristics, phytochemical composition, ecological and environmental relevance and diverse pharmacological activities of the plant.



Fig 1: *Bougainvillea glabra* Choisy bract

1. TAXONOMY [6]:

Kingdom	Plantae
Phylum	Magnoliophyta
Class	Magnoliopsida
Subclass	Caryophyllida
Order	Caryophyllales
Family	Nyctaginaceae
Genus	<i>Bougainvillea</i>
Species	<i>glabra</i>

2. VERNACULAR NAME [7]:

English	Paper flower
Hindi	Booganbel
Manipuri	Cherei
Bengali	Baganbilas
Marathi	Booganvel
Konkani	Bouganvila
Telugu	Kagithala Puvvu

3. DISTRIBUTION:

In 1768, French naturalist and explorer Philibert Commerson made the first discovery of the genus *Bougainvillea* in Rio de Janeiro, Brazil. He named it after his countryman, French sailor, and adventurer Louis Antoine de Bougainville [8].

Certain species of the genus *Bougainvillea glabra* Choisy are found worldwide and are not specific to any one place, species, cultivar, or hybrid, according to botanical textbooks. In view of these results, a more comprehensive study was carried out in the scientific literature. In this review, we emphasize a more reliable update on distribution that is grounded in scientific research or literature. has been introduced to Italy, Spain, France, Egypt, China, India, Israel, and Bangladesh United States of America, Guatemala, Honduras, Virgin Islands, Mexico, Nicaragua, Puerto Rico, Dominican Republic, Venezuela, Brazil, Madagascar, Nigeria, Nigeria, Hawaii, Bolivia, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, and Thailand [9].

4. DESCRIPTION [7,9]:

Evergreen, climbing woody vine which grows up to 1 – 12 m (4 – 40 ft). They are climbing shrubs or woody plants that produce leaves all year long. It can climb thanks to its thorny stems.

Leaves: The leaves are alternate, simple ovate-acuminate. Generally, 4–13 cm long and 2– 6 cm broad. They are evergreen, display a pinnate venation pattern, and are arranged alternately. They are simple leaf with leaf blades are generally less than 5 cm long, lanceolate in shape with undulate margins, and have a smooth texture.

Flowers: The plant's flowers are small and often white, but each cluster of three petals is encircled

by three or six bracts that are either pink, magenta, purple, red, orange, white, or yellow. The true flowers range in size from 0 to 1.5 cm, are solitary, and are bisexual (monoecious). Their blooming season is mostly spring and summer, and they are not aromatic.

Habitus of growth: *Bougainvillea glabra* Warm, semi-warm, dry, semi-dry, and temperate temperatures are ideal for bougainvillea development and flowering. They also thrive in acidic, well-drained soils with a pH of 5.5–6, and they can withstand droughts.

Fruit: It has an elongated fruit that is no longer than 1 cm.

5. ACTIVE CONSTITUENTS:

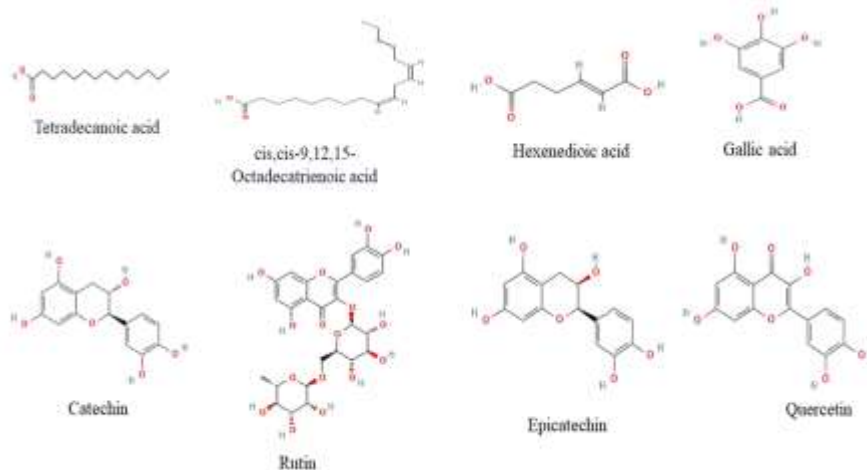


Fig 2: Chemical constituents *Bougainvillea glabra* Choisy

Phenols, tannins, flavonoids, terpenoid, alkaloids, steroids, glycosides, betacyanin, fatty acids, vitamins, essential oil, and other phytoconstituents are all present in the plant [6]. GC-MS analysis of leaves revealed a variety of phytochemicals like Tetradeanoic acid, ethyl ester, 3-O-Methyl-d-glucose, Phenol, 9,12,15-Octadecatrienoic acid, Hexenedioic acid, 1,2-Benzene dicarboxylic acid, diisooctyl ester, Squalene, Vitamin E, and phytol [10].

HPLC–UV/Vis analysis of methanol and dichloromethane (DCM) extracts from *B. glabra* aerial and floral parts were measured for the presence of 22 phenolic compounds. The primary phenolics identified by HPLC-PDA analysis were gallic acid, epicatechin, rutin, catechin, and benzoic acid. Similarly, significant phenolic, flavonoid, terpenoid, and alkaloid derivatives were identified using UHPLC–MS analysis [11].

The bract's initial phytochemical screening revealed the presence of triterpenes, steroids,

tannins, and flavonoids. The Additionally, the ethanolic extract of *B. glabra* bract showed substantial levels of flavonoids and phenols, with 250.10 ± 22.59 QE mg/100 g and 76.74 ± 2.38 GAE mg/100 g, respectively. It was discovered that the ethanolic extract of *B. glabra* bract had a low total betalain concentration. Quercetin was identified by HPLC-PDA analysis as the main flavonoid component that gave the extract its antioxidant properties [12].

6. TRADITIONAL USES [13]:

Traditional medicine makes extensive use of *B. glabra* involucre to treat a variety of ailments, including respiratory disorders. In Mexico, *B. glabra* is known by a variety of names, such as purple bugambilia, paper flower, and Santa Rita. It is also recognized by indigenous languages such as katsjoxhuan (Popolac), jukua, and shpupukuishonot (Mixtec). The most regularly utilized component in Mexican traditional medicine to cure respiratory ailments like cough, asthma, flu, and bronchitis through a variety of recipes are the bracts of the *Bougainvillea* plant, which are sometimes mistaken for flower petals. Additionally, it has been used to treat lung pain, whooping cough, drowning, urine sickness, acne, wound cleaning, and gastrointestinal problems like diarrhoea and dysentery.

In Nigeria, it is used as an analgesic and to cure inflammation. In Thailand, flowers are used to cure nausea and stomach-aches. In Mandsaur, India, *bougainvillea* is used to cure hepatitis, leukorrhea, heartburn, sore throat, and blood vessels. Extracts from *B. glabra* are used to treat digestive ailments in Africa. Extracts from *B. glabra*, commonly referred to as "glory of the garden," have been demonstrated to inhibit tyrosinase and TNF activity, increase the production of collagen, and have antiviral, antimicrobial, antioxidant, insecticide, larvicide,

antidiabetic, antilipidemic, antihyperglycemic, hepatoprotective, antiulcer, anthelmintic, antipyretic, antifertility, and anticancer properties. Because of their non-toxic and antioxidant qualities, *Bougainvillea* betalains have been the subject of more research on their potential applications as food, cosmetic, textile, and medicinal pigments.

Although several natural syrups made from *Bougainvillea* are already available to treat respiratory tract pain, they are typically only used as supplements due to the lack of scientific research proving their safety and effectiveness. *B. glabra* is regarded as one of the plant species of major horticultural importance globally because of its ramifications and profusion of colourful inflorescences that provide walls, gates, or pergolas in gardens a startling aspect.

7. ECOLOGICAL AND ENVIRONMENTAL RELEVANCE:

In 1860, *B. glabra* was transported to Mauritius, and in 1869, it was carried to Calcutta. In the 1960s, a wide variety of *bougainvillea* was brought to India from around the globe. Because of their vibrant bracts, *Bougainvilleas* have a powerful impact on the landscape and beautifully change the site's appearance. *Bougainvilleas* are used extensively in landscaping because of this. Since it is also thorny, *bougainvillea* may readily fulfil its functional purpose as a screening and protective hedge. Any location can be transformed into a vibrant landscape with *Bougainvillea* [14].

Additionally, *Bougainvillea* is needed for clearing up environmental pollutants. This plant absorbs dust, gasses, and other toxic substances. These plants are frequently found on traffic islands, greenbelts, central verges, road barriers, and other areas because of their ability to reduce pollution. It has recently been discovered that *Bougainvillea* is



a plant that can withstand pollution and can aid in reducing air pollution. Physical investigations conducted on *Bougainvillea* leaves have demonstrated that this plant reduces dust and absorbs contaminants from its surroundings. As a result, it is strongly advised for plantations in industrial and urban regions where particulate matter is an issue.

Bougainvillea glabra's superior anticipated performance index (API) and higher air pollution tolerance index demonstrated its ability to withstand stress from traffic pollution. Because of its great dust-trapping ability and tolerance, as demonstrated by its high APTI and API values, this plant is recommended as a model plant to be planted on roadways to reduce particle matter [14,15].

Bougainvillea is a plant that can withstand wind, dryness, and salt. It needs a small amount of water. *Bougainvillea* is used as bonsai, hanging baskets, pots, specimen plants, and accent plants. *Bougainvillea* is perfect for warm climates, since it can withstand drought. It is indigenous to Brazil's beaches and is a natural choice for coastal areas due to its excellent salt resistance [15].

The betalains that give *B. glabra* bracts their colour which attract pollinators and seed dissemination. Pollinators are crucial to our environment because they regulate 80% of the sexual reproduction of terrestrial plants, which maintains ecosystem function. In urban environments, *B. glabra* plays an important role in pollination, which keeps ecosystems healthy, landscape aesthetics, and pollution reduction [8].

8. PHARMACOLOGICAL ACTIVITIES:

- **Antioxidant activity:** Acetone and hydroalcoholic extract (50:50) of *Bougainvillea glabra* 'Snow White' displayed

significant antioxidant activity against DPPH free radical, ABTS free radical scavenging and superoxide scavenging by BHT (Butylated Hydroxy Toluene) as a standard [16].

- **Antimicrobial activity:** Hydroalcoholic extract *Bougainvillea glabra* leaf, revealed significant antimicrobial activity against *Candida albicans*, *Staphylococcus aureus*, and *Salmonella typhi* [17].
- **Analgesic activity:** The methanolic extract of *Bougainvillea glabra* leaves (MEBG) showed notable central and peripheral analgesic activity in animal models, comparable to standard drugs like pentazocine and indomethacin, due to its rich content of flavonoids and glycosides [18].
- **Antipyretic activity:** The methanolic extract of *Bougainvillea glabra* leaves (MEBG) exhibited remarkable central and peripheral antipyretic activity in animal models, comparable to reference drugs like pentazocine and indomethacin, due to its rich content of flavonoids and glycosides [18].
- **Anti-inflammatory activity:** The methanolic extract of *Bougainvillea glabra* leaves (MEBG) demonstrated potent central and peripheral anti-inflammatory activity in animal models, comparable to standard drugs like pentazocine and indomethacin, due to its rich content of flavonoids and glycosides [18].
- **Anticancer activity:** The hydroalcoholic extract of *B. glabra* was tested against human carcinoma cell line (HeLa) via MTT cytotoxicity assay, and the results demonstrated a noteworthy anticancer effect [6].



- **Antidiabetic activity:** Ethanolic extract of *Bougainvillea glabra* flowers and bracts strong anti-diabetic properties by enzyme inhibition, enhanced glucose uptake, and reduced lipid accumulation [1].
- **Hepatoprotective activity:** Ethanolic extract of *Bougainvillea glabra* leaves demonstrated potent hepatoprotective activity against paracetamol-induced liver damage in Wistar rats [19].
- **Anti-diarrhoeal activity:** Hydroalcoholic extracts of *Bougainvillea glabra* leaves demonstrated effective anti-diarrhoeal activity in castor oil-induced diarrhoea models in rats [6].
- **Anthelmintic activity:** The methanol, petroleum ether, ethyl acetate, and water extracts of *B. glabra* leaves were tested for anthelmintic activity. The methanolic extract had the most activity, causing paralysis and death in the shortest amount of time [20].

ACUTE TOXICITY [21]:

An acute oral toxicity study was conducted following OECD guideline 425 to assess the safety of a *Bougainvillea glabra* extract in healthy male and female rats. The rats were divided into three groups of five and were fasting for a whole night prior to dosing. The extract was administered orally at doses of 100, 500, and 2000 mg/kg body weight using a dosing volume of 10 mL/kg according to each rat's body weight. At the same volume, a control group was given only the vehicle. After the injection, the rats were closely observed for two hours to check for any changes in behavior or autonomy and, they were observed for 48 hours to check for signs of toxicity or death.

There was no indication of acute toxicity or death at any of the doses given, including the maximum dose of 2000 mg/kg. Additionally, the animals remained healthy and showed no symptoms of poisoning during a 14-day observation period. Based on these results and in accordance with OECD guideline 425, the extract is considered safe and non-toxic at the tested dose levels, indicating a significant margin of safety for oral consumption.

FUTURE PROSPECTIVES:

Extensive pharmacological and molecular studies are necessary to progress the clinical translation of *Bougainvillea glabra's* medicinal potential. According to OECD guideline 425, acute oral toxicity evaluations have validated its safety profile up to 2000 mg/kg in rodent models; however, additional research is necessary to isolate and structurally characterize its bioactive constituents using cutting-edge methods like NMR spectroscopy, GC-MS, and UHPLC-MS/MS. In view of its documented pharmacodynamic properties, mechanistic investigations at the molecular level ought to concentrate on signalling pathways, receptor interactions, and enzyme inhibition. Furthermore, to determine its safety for extended usage, long-term toxicological evaluations, such as sub-chronic and chronic toxicity, reproductive toxicity, and genotoxicity studies are essential.

CONCLUSION:

The *Bougainvillea glabra* Choisy, a colourful decorative plant belonging to the Nyctaginaceae family, has shown promise as a medicinal species because of its wide range of pharmacological effects and varied phytochemical profile. The plant contains high concentrations of flavonoids, phenols, alkaloids, terpenoids, and other bioactive compounds due to which it has antioxidant,



antimicrobial, antidiabetic, hepatoprotective, and anticancer qualities. The plant has long been used to treat respiratory, gastrointestinal, and inflammatory conditions. Combining traditional knowledge with scientific evidence reveals *Bougainvillea glabra* to be a powerful source of bioactive compounds with a variety of medicinal uses. Its potential as a useful botanical resource in contemporary phytomedicine is supported by its pharmacological diversity, aesthetic appeal, and ecological adaptability.

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HOW TO CITE: Nausheen, Ramdas Bhat, Multifaceted Insights into Bougainvillea Glabra Choisy from Morphology to Medicine, *Int. J. of Pharm. Sci.*, 2025, Vol 3, Issue 8, 52-59. <https://doi.org/10.5281/zenodo.16679848>