

A CRITICAL REVIEW ON PHARMACOGNOSTICAL, PHYTOCHEMICAL STANDARDIZATION AND PHARMACOLOGICAL EVALUATION OF ALTERNANTHERA BRASILIANA (L.) KUNTZE

Unnimaya. I. S¹, Dr. M. Rajan²

^{1,2}Department of Pharmacognosy and Phytochemistry, Nehru College of Pharmacy, Pampady, Thiruvilwamala,
Thrissur 680588, Kerala, India

ABSTRACT

Alternanthera brasiliana (L.) Kuntze Native to South and Central America, are blooming plants in the Amaranthaceae family. Penicillin or joy weed are common names for the perennial herbaceous plant *Alternanthera brasiliana* (L.) Kuntze in Brazil. It is a natural plant from the Neotropics that is used to treat diarrhoea, coughing, and inflammation due to the presence of flavonoids, alkaloids, phenolic compounds, amino acid and tannins. In North East India, it has historically been used as a hemostatic. The information on *Alternanthera brasiliana*'s ethno pharmacology, phytochemistry, and biological activity that has been published is compiled in this review. All of the research done on this plant is compiled in this review to give current knowledge for upcoming projects.

Key words: *Alternanthera brasiliana* (L.) Kuntze, diarrhea, coughing, inflammation, alkaloids, flavonoids.

1. INTRODUCTION

One significant source of therapeutic treatments for a wide range of illnesses is medicinal plants. Different portions of medicinal plants have been employed for distinct medical purposes all throughout the world since ancient times. India is referred to as the "Botanical Garden of the World" because of its extensive variety of medicinal plants.^[1] Since ancient times, medicinal plants have been utilized for medical purposes. The use of medicinal plants fits into all current preventive measures and plays a dynamic role in illness prevention. Herbal medicine is the subject of even more research and uses in medical care. therapeutic plants are an important source of molecules with phytochemical elements that have therapeutic qualities; these plants are useful for treating human illnesses and have a vital function in healing.^[2] The use of plants for therapeutic and medical purposes in order to treat illnesses and enhance human health is known as herbal medicine, or phytomedicine. Phytochemicals are the secondary metabolites found in plants (the word "Phyto" comes from the Greek word "Plant"). Phytochemicals are active substances that are regarded as drugs or medicines because of their medicinal qualities.^[3]

The quality and safety of plant-derived medicines should be thoroughly and accurately studied due to the growing global use of natural substances. Traditional and millennial beliefs regarding these matters cannot be reliably trusted, so enlightening and scientific studies are necessary to obtain trustworthy information for the use of medicinal plants in health care.^[4]

Brazil has one of the world's richest floras for herbal remedies. Brazilian joy weed, often known as penicillin, is a herbaceous plant belonging to the Amaranthaceae family, *Alternanthera brasiliana* (L.) Kuntze. Being a native neotropical species, it grows easily on deforested and poor soil. It is both a wild medical plant and a decorative. This plant, which grows naturally in bushes and by the sides of roads, is both decorative and curative. In Brazilian traditional medicine, it is used to treat diarrhea, coughing, and inflammation.^{[1][5]}

TAXONOMY

- Kingdom: Plantae
- Phylum: Magnoliophyta
- Division: Angiospermae
- Class: Magnoliopsida
- Order: Caryophyllales
- Family: Amaranthaceae
- Genus: *Alternanthera*
- Species: *Brasiliana*
- Species authority: Linn

2. ETHNOMEDICINAL USES OF ALTERNANTHERA BRASILIANA

In Brazil, the plant is utilized as a herbal remedy, especially for pain, inflammation, infections, coughing, and tumour growth. The plant is used worldwide in traditional medicine to treat indigestion, headaches, gripes, and colds. *Alternanthera brasiliana* is used in Bihar to treat post-natal symptoms, diarrhea, dysentery, night blindness, fuzzy vision,

and wound healing. Additionally, it has been used as an immunological modulator, analgesic, antipyretic, antibacterial, and to treat a variety of illnesses, including gonorrhoea and lymphocyte proliferation. Boils benefit from the herb's poultice. The herb is used as a febrifuge, diuretic, galactagogue, cholagogue, and abortifacient. The plant's ether extract has antiulcerative properties. ^[5]

3. MORPHOLOGICAL CHARACTERISTICS

Alternanthera brasiliana (L.) Kuntze, Amaranthaceae is an herb indigenous to Brazil, described as perennial, prostrate and branchy 7.5- 45.0 cm long, presenting a circular to polygonal stem in transection, long internodes and swollen nodes, at which opposite leaves attach. Branches 7.5- 45.0 cm long, glabrous, the ultimate ones with two lines of hair, nodes often villous; leaves 2.5-7-5 cm, even longer when growing in watery places, rather fleshy, sometime obscurely denticulate; flowers inconspicuous, white, in clusters; seeds 1.25-1.5mm, sub- orbicular. The inflorescence is cymes, composed of hermaphrodite, actinomorphic and monocyclic flowers. ^{[6][7]}



Leaves



Flower



Stem

CHARACTERS OBSERVED	ALTERNANTHERA BRASILIANA
a. Habitat	<ul style="list-style-type: none"> Cultivated in gardens and as weed on roadsides.
b. Habit	<ul style="list-style-type: none"> Herbaceous, perennial plant
c. Roots	<ul style="list-style-type: none"> Rooting at nodes
d. Nature and colour of stem	<ul style="list-style-type: none"> Reddish, hairy
e. Shape of entire leaf	<ul style="list-style-type: none"> Elliptic
f. Length of leaf (cm)	<ul style="list-style-type: none"> 13 cm
g. Breadth of leaf(cm)	<ul style="list-style-type: none"> 6 cm
h. Shape of leaf apex	<ul style="list-style-type: none"> Acuminate
i. Shape of leaf margin	<ul style="list-style-type: none"> Entire
j. Shape of leaf base	<ul style="list-style-type: none"> Cuneate
k. Colour of leaf	<ul style="list-style-type: none"> Metallic wine red above, purple beneath
l. Petiole	<ul style="list-style-type: none"> Indistinct, short
m. Nature of inflorescence	<ul style="list-style-type: none"> Pedunculate globose white Heads
n. Perianth	<ul style="list-style-type: none"> Ovate –lanceolate, 4mm long, 3- nerved, hairy
o. Number of stamens	<ul style="list-style-type: none"> Five
p. Flowering season	<ul style="list-style-type: none"> Throughout the year
q. Number of seed	<ul style="list-style-type: none"> One
r. Fruits	<ul style="list-style-type: none"> Utricle orbicular
s. Cultivation	<ul style="list-style-type: none"> Seed and cuttings

Geographical Source

Native to tropical and subtropical parts of Australia and South America, these perennial herbs are evergreen. For their decorative leaves, which come in shades of green and yellow, bronze and green, or red and pinkish brown, a number of species are planted. There are five species known to exist in India. It can be found in the hottest regions of India and

even reaches 1,200 meters in the Himalayas. It is also grown as a pot herb. It is particularly prevalent near ponds and tanks. ^[6]

Phytoconstituents in *Alternanthera brasiliana* (L.) kuntze ^{[5][7]}

The qualitative phytochemical screening of leaf extracts indicated the presence of alkaloids, phenols and flavonoids, saponins, tannins, phytosterols, proteins and carbohydrates. Hexane, chloroform and methanol leaf extracts possessed carbohydrate, phenols and tannins. Carbohydrates, fats and proteins are required to meet the human needs for energy and life processes. Phytochemicals or secondary metabolites which vary amongst plant organs and stages of development usually occur as complex mixtures. Phenolic compounds which are important plant derived bioactive compounds were detected and are responsible for antioxidant property as they have the ability to scavenge free radicals due to their hydroxyl groups.

There are further reported presences of β sitosterol, lanosterol, stigmasterol, a saturated aliphatic ester, and a saturated ester. To find the substances causing the water-soluble phase of an ethanolic leaf extract to have an antiproliferative impact on lymphocytes, bioassay-guided fractionation was used. There were six flavonoids found: (1) kaempferol 3-O-robinobioside-7-O- α -L-rhamnopyranoside or robinin; (2) quercetin 3-O-robinobioside-7-O- α -L rhamnopyranoside or clovin; (3) quercetin 3-O-robinobioside; (4) kaempferol 3-O-robinobioside; (5) and (6) kaempferol 3-O-rutinoside. The primary 3-O-robinobioside derivatives of quercetin and kaempferol are found in *Alternanthera brasiliana*. Of the six flavonoids that were extracted, four contained the kaempferol skeleton.

SL NO:	NAME OF THE CONSTITUENT	PLANT PARTS
1.	2''-O-Ramnosylvitexin	Aerial part
2.	4',5,7-trimethoxy-2''-Oramnosylvitexin	Aerial part
3.	Ligustroflavone	Aerial part
4.	Vitexin or Apigenin-8-C-glucoside	Aerial part
5.	2''-O- α -L-rhamnopyranosyl vitexin	Aerial part and whole plant
6.	Quercetin	Aerial part and whole plant
7.	2''-O- β -D-glucopyranosyl vitexin	Aerial part and whole plant
8.	Crysoeriol(5,7,4'-trihydroxy-3'- methoxyflavone)	Flower
9.	Tricin(5,7,4-trihydroxy-3',5' -dimethoxyflavone)	Flower
10.	7-O- β -D-glucopyranoside-5,4'- dihydroxy-3'-methoxyflavone	Flower
11.	Kaempferol-3-O-robinobioside-7-O- α -L rhamnopyranoside or Robinin or Kaempferol-3-Orutinoside-7-O- α -L-rhamnopyranoside	Leaves
12.	Kaempferol-7- O-glucoside	Leaves
13.	Quercetin 3- β -D-glucoside	Leaves
14.	Quercetin-3-O-robinobioside-7-O α -L-rhamnopyranoside or Clovin	Leaves
15.	Quercetin-3-O-robinobioside or Quercetin-3-O-rutinoside or Rutin	Leaves
16.	Kaempferol-3-O-robinobioside or Kaempferol-3-O-rutinoside	Leaves
17.	Isorhamnetin-3-O-robinobioside or Isorhamnetin-3-O-rutinoside	Leaves and aerial part
18.	Kaempferol-rhamnosyl- rhamnosylglycoside	Leaves
19.	Stigmasterol	Leaves
20.	β -Sitosterol	Leaves
21.	Δ^7 -Spinasterol or α -Spinasterol	Aerial and whole plant
22.	3 β -Hydroxystigmast-5-en-7-one	Leaves

23.	Sitosterol-3-O-β-Dglucopyranoside	Leaves
24.	Ferulic acid	Whole plant and leaves
25.	p-Coumaric acid Ferulic acid	Leaves and aerial parts
26.	4-Hydroxybenzoic acid	Leaves
27.	2,5-Dihydroxybenzoic acid or gentisic acid	Leaves
28.	Chlorogenic acid	Leaves
29.	2,5-Dihydroxybenzoic acid 5-O-βD-glucoside	Leaves
30.	24-Methylene-cycloartanol	Leaves
31.	Dopamine-betaxanthin	Leaves
32.	3-Methoxytyramine-betaxanthin	Leaves

Proximate Analysis

The following values were obtained from an analysis of *Alternanthera brasiliana*'s edible portion: The following numbers are measured per 100g: moisture (77.4), protein (5.0), fat (0.7), fiber (2.8), carbs (11.6), minerals (2.5g/100g), calcium (510.0), phosphorus (60.0), iron (16.7), riboflavin (0.14), niacin (1.2), vitamin C (17.0 mg/100g), carotene (1926μg/100g), and energy (73kcal).

Elemental Analysis ^[8]

Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES) was used to analyse elements. It's among the most often used methods for elemental analysis. This method has good detection limits, multi-element capacity, and high specificity. Macro, micro, and other necessary elements were found, according to elemental analysis. Significant concentrations of calcium, potassium, magnesium, phosphorus, nitrogen, carbon, sulphur, and hydrogen were found. Much smaller amounts of elements including copper, zinc, and sodium were found. The element with the highest concentration, carbon, is determined to be 384.7 mg/g. It is followed by H at 59.2 mg/g, N at 47.8 mg/g and K at 21.1 mg/g.

SL NO:	ELEMENTS	CONCENTRATION (mg/g)
1.	H	384.7
2.	N	59.2
3.	C	47.8
4.	S	6.6
5.	Ca	18
6.	K	21.1
7.	Mg	9.1
8.	P	1.4
9.	Cu	0.01999
10.	Zn	0.28727
11.	Na	0.94332

Pharmacological Activities of *Alternanthera brasiliana* (L.) Kuntze

Wound healing Activity ^[8]

In comparison to the control group, the *Alternanthera brasiliana* (5% w/w) treated group showed a significantly higher percent contraction of wound when the methanolic extract of the leaves of the plant was assessed for its ability to heal wounds in Sprague Dawley rats using the Chorioallantoic membrane (CAM) model. *Alternanthera brasiliana* methanolic extract significantly increases tensile strength and angiogenesis.

Anti-Inflammatory and Analgesic Activity ^{[9][10]}

According to recent discoveries, methanolic and hydro-alcoholic extracts from *Alternanthera brasiliana* callus and invitro-cultivated plantlets shown analgesic effects in various in vivo pharmacological models. Two chemical nociception models in mice were used to analyze methanolic extracts of *Alternanthera brasiliana* (L.) Kuntze plantlets

grown under various light spectral quality conditions. The plantlets grown under blue and white light treatments had the maximum biomass yield, according to the results. Methanolic extracts from *Alternanthera brasiliana* grown in various lighting conditions and a few reference medications had analgesic effects on mice's acetic acid-induced abdominal constrictions and capsaicin test (10 mg/kg, i.p.). At 10 mg/kg body weight, the methanolic extracts (white and blue lights) inhibited the capsaicin test by 22 and 45.5% and the writhing test by 51 and 62.5%, respectively.

This investigation showed that *Alternanthera brasiliana* flavonoids significantly reduce the painful stimuli. More specifically, it was observed that the 100 mg/kg keto-alcoholic leaf extract significantly decreased the amount of writhing animals.

When compared to the negative control group, the study assessed the analgesic and anti-inflammatory activity of the aqueous extract of *Alternanthera brasiliana*, which resulted in a significant decrease in the number of writhing at all tested doses; the dose of 400 mg/kg showed the largest reduction (96.55%). In contrast, smaller concentrations of *Alternanthera brasiliana* extract significantly reduced the amount of writhing in mice in this investigation, by 48% (100 mg/kg) and 40% (300 mg/kg).

For every dosage under investigation, the aqueous extract of *Alternanthera brasiliana* leaves significantly lowers the quantity of abdominal contractions. *Alternanthera brasiliana* leaf aqueous extract may have pharmacological effects on pain and inflammation.

Antibacterial Activity ^{[11][12][13]}

Alternanthera brasiliana (L.) Kuntze is a plant that is used to treat asthma and bronchitis since the entire plant demonstrates antibacterial action. *Alternanthera brasiliana* (L.) Kuntze's crude methanolic extract exhibits antibacterial properties against *Candida albicans*, *Saccharomyces cerevisiae*, *Bacillus subtilis*, *Escherichia coli*, and *Staphylococcus aureus*. These microorganisms generated resistance against *Alternanthera brasiliana* methanolic extract. Inhibition zones against *Staphylococcus aureus* were detected by the ethyl acetate and chloroform sub-fractions. In *Alternanthera brasiliana*, the presence of flavonoids such as quercetin contributes to the antibacterial activity.

Only the ethyl acetate extract showed activity against *Candida albicans* (MIC 1.56 mg/mL), and the ethyl acetate and chloroformic fractions had a value of 1.56 mg/mL (MIC) against *Enterococcus faecalis*. *Alternanthera brasiliana*'s hexane extract shown possible antibacterial action, particularly against a pathogenic strain of *E. coli*.

Neuropharmacological Activity ^[14]

The purpose of the study was to assess how well an ethanolic plant leaf extract affected mice's anxiety, convulsions, and novelty-induced behaviour. It was decided to use the intraperitoneal (i.p.) and oral (p.o.) routes to measure the acute toxicity (LD50). The anxiolytic, sedative, anticonvulsant, and novelty-induced behaviours of ELE (250, 500, and 1000 mg/kg, p.o.) were assessed. According to the study, *Alternanthera brasiliana* leaf extract in ethanolic form stimulates the central nervous system and has mild anxiolytic and stimulatory effects but no anticonvulsant effects.

Antitumor Activity ^{[15][16]}

The anticancer potential of *Alternanthera brasiliana* (EAAB) ethyl acetate extract against Ehrlich ascites carcinoma (EAC) in Swiss albino mice was investigated. EAAB's anticancer efficacy was assessed at 200 and 400 mg/kg. After cancer was induced, extract was given for 14 days in a row. After 18 hours of fasting and 24 hours after the last injection, half of the mice were slaughtered; the remaining animals were kept alive to determine whether their lifespan had increased. In order to test the extract's potential as an anticancer, factors such as tumour volume, viable and non-viable tumour cell count, tumour weight, and haematological and biochemical parameters of the EAC-bearing host were evaluated. It was found that EAAB exhibits strong dose-dependent antitumor action.

Alternanthera brasiliana leaf extract hydroethanolic extract also has anticancer properties. The leaf extracts' potential for toxicity against DLA tumour cells was demonstrated by the in vitro MTT test.

Antinociceptive Activity ^[17]

The antinociceptive properties of a methanolic extract of *Alternanthera brasiliana* (L.) Kuntze leaves were evaluated in peripheral, non-narcotic models such as the acetic acid-induced writhing syndrome test, as well as narcotic analgesic models such as the tail flick and hot plate test. When administered, the methanolic extract of *Alternanthera brasiliana* provided significantly ($P < 0.01$) higher results than the control.

Antifungal Activity ^[18]

The presence of seed-borne mycoflora was examined in the seeds of four varieties of Bambara nuts (*Vigna subterranea*). From the aforementioned samples, phytopathogenic fungus, including *Aspergillus niger*, *Aspergillus flavus*, *Aspergillus clavatus*, and *Alternaria alternata*, were isolated. Four cultivars' seeds showed fungal incidence rates ranging from 40% to 75%; cream white had the greatest percentage incidence and red nut the lowest. After a fair evaluation, it

was discovered that the various percentages of fungal infection on seeds caused by the isolated fungi ranged from 0.00 to 9.25%. At various doses (10%, 20%, 30%, and 40%), the fungal toxic effects of *Alternanthera brasiliana* aqueous leaf extracts to restrict the radial mycelia growth of the isolated fungi were assessed.

At 40% concentration, the results demonstrated a greater vegetative development retardation. This study has demonstrated the ability of botanicals to manage *Alternaria* and *Aspergillus*-caused seed-borne mycoflora of Bambara nuts in storage.

4. CONCLUSION

It is seen from the literature that *Alternanthera brasiliana* (L.) Kuntze is important for the large number of medicinal properties. And the qualitative and quantitative phytochemical analysis of various extracts of the leaves revealed important phytoconstituents like riboflavin, niacin, stigmasterol, flavonoids that are responsible to produce various pharmacological activities like Wound healing, Anti-inflammatory, Analgesic activity, Antibacterial activity, Antidiabetic activity, Antitumour activities. Lot of traditional uses are also reported like diarrhoea, constipation, cough, dysentery, night blindness and inflammatory conditions.

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