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Phytopharmacology of *Alternanthera brasiliana* (Amaranthaceae): A Brazilian plant

Firoj Alam^{*1}, Nitin Kumar¹, A. Khatoon¹

1. Faculty of Pharmacy, Integral University, Lucknow-226026

[Email: firojalam29@gmail.com]

Abstract: *Alternanthera brasiliana* L. (Amaranthaceae) is evergreen, perennial herbs, native to tropical and sub-tropical regions of Brazil, Australia & South America. *Alternanthera* are grown for edging beds and for bedding. The hardy plant stand trimming, and can be easily propagated by cutting or by division. All of its parts are used in traditional system of medicine; leaves are the most important parts which are use medicinally.

Keywords: *Alternanthera brasiliana*, Amaranthaceae, Taxonomy, Phytochemistry, Pharmacological Actions

Introduction: World Health Organization (WHO) and European Union (EU) issued several guidelines and acts concerning safe and appropriate use of herbal medicines.¹⁻³ Safety issues related to herbal medicine are complex, and comprise possible toxicity of natural herbal constituents, presence of contaminants or adulterants, and potential interactions between herbs and prescription drugs.⁴ Use

of indigenous drugs from plant origin forms a major part of complementary and alternative medicine/traditional medicine (CAM/TM). The world market for herbal medicine, including herbal products and raw materials has been estimated to have an annual growth rate between 5 &15%. The Indian medicinal plants-based industry is growing at the rate of 7–15% annually.⁵

Alternanthera brasiliana (L.) O. Kuntze, (Amaranthaceae) is an important herb found as a perennial herb, native to tropical and subtropical regions of Australia and South America; five species have been recorded from India. Through almost all of its parts are used in traditional system of medicines, leaves are the most important parts which are used medicinally.⁶ It is a herb indigenous to Brazil, described as perennial, prostrate and branchy, presenting a circular to polygonal stem, long internodes and swollen nodes at which opposite leaves attach. The inflorescence is cymes, composed of hermaphrodite, actinomorphic and monocyclic flowers.⁷

Alternanthera brasiliana is a Brazilian plant occurring in several regions, being known as “penicilina” or terramicina, widely used by rural communities as medicinal agent to cure different disease, such as inflammation, and dolorous or infection processes, wound healing, analgesic, antitumor activity, immunomodulator and lymphocyte proliferation. *Alternanthera brasiliana* focusing the influence of different kind of lights to produce compound with possible analgesic action.⁸ It is used against cough & diarrhoea in Brazilian popular medicine.⁹

Here the aim was to summarize the more recent common actions and therapeutic application of *Alternanthera brasiliana* and its active constituent.

Taxonomic classification:

Kingdom	-	Plantae
Subkingdom	-	Tracheobionta
Super division	-	Spermatophyta
Division	-	Magnoliophyta
Class	-	Magnoliopsida
Subclass	-	Caryophyllidae
Order	-	Caryophyllales
Family	-	Amaranthaceae
Genus	-	<i>Alternanthera</i>
Species	-	<i>brasiliana</i>

Vernacular name:

Latin	-	<i>Alternanthera brasiliana</i>
Unani	-	Machhechhi
Tamil	-	Ponnonkanni
Siddha	-	Ponnonkanni
Ayurvedic	-	Matsyaakshi, matsyaakshika, minaakshi.

Geographical source:

It is evergreen, perennial herbs, native to tropical and sub-tropical regions of Australia & South America. Several species are grown for their ornamental leaves which are variegated green and yellow, or bronze and green, or red and pinkish brown. Five species have been recorded from India. It is found throughout hotter parts of India, ascending to an altitude of 1,200 m in Himalayas; also cultivated as a pot- herb.⁶ It is found especially around tank and ponds.¹⁰

Morphology:

Alternanthera brasiliana (L.) O. 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.



**Figure 1: Leaves & Flowers of
*Alternanthera brasiliana***

The leaves are simple, entire, decussate, oval-lanceolate and purple, presenting uniseriate epidermis, pluricellular non-glandular trichomes coated by papillose cuticle, anomocytic and diacytic stomata on both surfaces; the mesophyll is dorsiventral, with collateral vascular bundles and druses. The stem, in secondary growth, has the dermal system similar to the leaf; the angular collenchyma alternates with the

chlorenchyma; it occurs druses and a cambial variant, consisting of concentric arcs of extra-cambial outside the first cambium and aligned vascular bundles in the pith.⁷

Traditional Uses:

Traditionally, the plant is used as a galactagogue, cholagogue, abortifacient and febrifuge. It is also used for indigestion. The leaves are used like spinach, and in soups. It is claimed to be a good fodder which increases milk in cattle. In some parts of Bihar, the plant is used for hazy vision, night blindness, diarrhea, dysentery and post-natal complaints. The poultice of the herb is reported to be used for boils. An ether extract of the plant yields an active principle having antiulcerative property. It has very high iron content, and may be used as a salad. The herb is said to possess diuretic properties and its decoction is taken in gonorrhoea.⁶

Phytochemistry:

Analysis of the edible portion of *Alternanthera brasiliana* gave the following values: moisture, 77.4; protein, 5.0; fat, 0.7; fibre, 2.8; carbohydrates, 11.6; minerals, 2.5g/100g; calcium, 510.0; phosphorus,

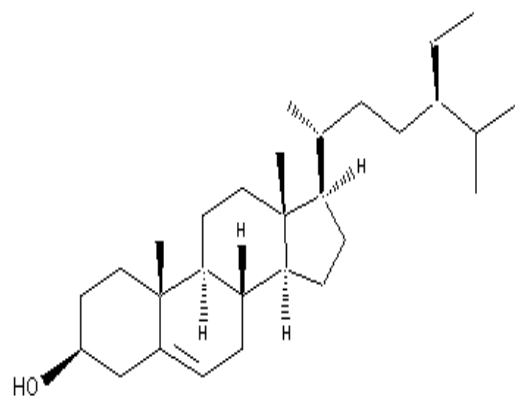
60.0; iron, 16.7; riboflavin, 0.14; niacin, 1.2; and vitamin C, 17.0mg/100g; carotene, 1926µg/100g; and energy, 73kcal. Stigmasterol, lanosterol, β -sitosterol, a saturated aliphatic ester, and a saturated ester are also reported to be present.⁶ Some elements, such as P, S, K, Ca, Mn, Fe, Cu, Zn, Sr, and Pb were detected in all samples, and the elements Cl, Ti, Cr, Co, Ni, Br, Rb, Sr, Cd, Sn, Sb, and Ba were detected in some samples.¹¹

Bioassay-guided fractionation of a water-soluble phase of an ethanolic leaf extract was carried out with the aim of identifying compounds responsible for the antiproliferative effect of the crude extract on lymphocytes.

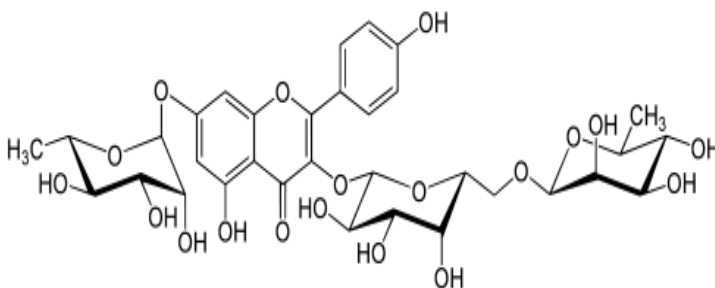
Six flavonoids were identified: kaempferol 3-O-robinobioside-7-O- α -L-rhamnopyranoside or robinin (1), quercetin 3-O-robinobioside-7-O- α -L-rhamnopyranoside or clovin (2), quercetin 3-O-robinobioside (3), kaempferol 3-O-robinobioside (4), kaempferol 3-O-rutinoside-7-O- α -L-rhamnopyranoside (5) and kaempferol 3-O-rutinoside (6). Their structures were elucidated by ¹H- and ¹³C-NMR data and agree with literature data.

Alternanthera brasiliana contains mainly 3-O-robinobioside derivatives of kaempferol and quercetin. The kaempferol skeleton was present in four of the six flavonoids isolated. Additional glycosylation was observed at C-7 for 1, 2 and 5. Only two flavonoids (5, 6) showed a rutinosyl instead of a robinobiosyl moiety at C-3. These results demonstrate that the 1→6 galactopyranosyl rhamnopyranosyl linkage is prevalent among the *A. brasiliana* flavonol glycosides.

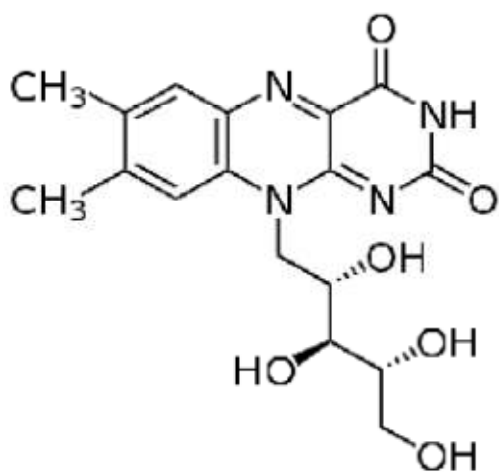
Flavonoids 1-6 are reported here for the first time for *Alternanthera*. Kaempferol 3-O-robinobioside and 3-O-rutinoside inhibited lymphocyte proliferation to a greater extent and were twice as active as the crude extract.^{4, 12} The anti-inflammatory effects observed in vivo can be attributed to the effects of these flavonoids on T-cell function, thereby accounting for the medicinal properties of *Alternanthera brasiliana*.⁹



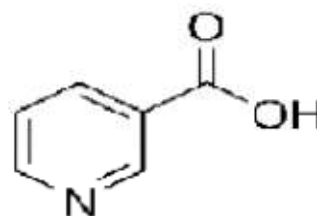
β – Sitosterol



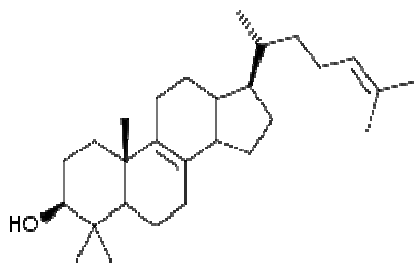
Robinin



Riboflavin



Niacin



lanosterol

Figure 2. Structures of some phytoconstituents isolated from *Alternanthera brasiliana*

Pharmacological Actions:

Anti-inflammatory and Analgesic activity

Methanolic and hydro - alcoholic extracts obtained from *A. brasiliana* invitro cultivated plantlets and callus presented analgesic properties in recent findings with different in vivo pharmacological models.¹³

The methanolic extracts of *Alternanthera brasiliana* (L.) Kuntze plantlets cultured under different spectral quality of lights were analyzed by two chemical nociception models in mice. The results showed a highest biomass yield in plantlets developed under blue and white light treatments. Analgesic effect of methanolic extracts obtained from *A. brasiliana* growing under different lights and some reference drugs on acetic acid-induced abdominal constrictions

and capsaicin test in mice (10 mg/kg, i.p.). The methanolic extracts (blue and white lights) at 10 mg/kg body weight caused inhibition of 51 and 62.5% against writhing test and 22 and 45.5% against capsaicin test, respectively.⁹

Wound Healing Activity

Wound healing activity of methanolic extract of leaves of *Alternanthera brasiliana* was evaluated in Sprague Dawley rats and by Chorioallantoic membrane (CAM) model, compared to the control group, percent contraction of wound was significantly higher in *Alternanthera brasiliana* (5% w/w) treated group. Methanolic extract of *Alternanthera brasiliana* significant increase angiogenesis and tensile strength.¹⁴

Antibacterial activity

The whole plant of *Alternanthera brasiliana* (L) Kuntz shows antibacterial activity, and the plant used in bronchitis and asthma.¹⁵

The crude methanolic extract of *Alternanthera brasiliana* (L.) Kuntze have antimicrobial activities against *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Escherichia coli*, *Bacillus*

subtilis, *Micrococcus luteus*, *Candida albicans*, *Saccharomyces cerevisiae*. These microbes produced resistant against methanolic extract of *Alternanthera brasiliana*.¹⁶

Effect on lymphocyte proliferation in human

The extract of the *Alternanthera brasiliana* Kuntze yielded six di- and triglycosyl kaempferol and quercetin derivatives. These are kaempferol 3-O-robinobioside-7-O- α -L-rhamnopyranoside or robinin, quercetin 3-O-robinobioside-7-O- α -L-rhamnopyranoside or cloven, quercetin 3-O-robinobioside, kaempferol 3-O-robinobioside, kaempferol 3-O-rutinoside-7-O- α -L-rhamnopyranoside and kaempferol 3-O-rutinoside. Their structures were elucidated based on the ¹H- and ¹³C-NMR data and are reported here for the first time in this genus. Kaempferol 3-O-robinobiosides and kaempferol 3-O-rutinoside significantly inhibited the human lymphocyte proliferation in vitro to a greater extent (IC₅₀= 25 μ g mL⁻¹).¹⁰

Miscellaneous actions

The areal part of *Alternanthera brasiliana* use in cystitis², throat and general infarction,

antibiotic, and antiviral against virus-herpes simplex I.¹⁶ The plant also shows antioxidant activity.¹⁷

Conclusion:

It is seen from the literature that *Alternanthera brasiliana* is a very important plant for its large number of medicinal properties as well as important chemicals like riboflavin, niacin, stigmasterol, lanosterol, β -sitosterol, and flavonoids. The plant shows many pharmacological activities like anti-inflammatory, analgesic, wound healing, antitumor, immunostimulant and antimicrobial activities. It is used against inflammation, cough and diarrhoea in Brazilian popular medicine.

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