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REVIEW ON ALTERNANTHERA BRASILIANA (L.) KUNTZE FOR ITS PHARMACOGNOSTIC, PHYTOCHEMICAL, PHARMACOLOGICAL PERSPECTIVES

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ABSTRACT

Alternanthera brasiliana (L.) Kuntze is a flowering plant in Amaranthaceae family that is native to South America and Central America. *Alternanthera brasiliana* (L.) Kuntze is a perennial herbaceous plant commonly known in Brazil as penicillin or Joy weed.it all the plant parts have been used medicinally however the leaves are of prime importance as it is used in folkloric treatment of malaria, pains, infections and diabetes. phytochemical analysis of the plant *Alternanthera brasiliana* revealed the presence of high content of flavonoids, carbohydrates and phenolic compounds, elements, such as P, S, K, Ca, Mn, Fe, Cu, Zn, Sr, and Pb were also detected. The plant shows many pharmacological activities like anti-inflammatory, analgesic, wound healing, antitumor, antiociceptive, antiviral, immunostimulant and antimicrobial activities The current review summarizes published information about the ethnopharmacology, phytochemistry, biological activities of *Alternanthera brasiliana*. The present review summarizes all the research work carried out on this plant in order to provide updated information for future works.

KEYWORDS: Alternanthera brasiliana, Flavonoids, Antibacterial.

INTRODUCTION

Medicinal plants have been a part of human life since ancient times, and their role in the treatment of various illnesses is unquestionable. Because of their complex molecular structures and ability to interact with mammalian target cells, plants have been employed in the development of new drugs. Moreover, synthetic drugs are very expensive to develop

since for the successful introduction of a new product approximately 3000-4000 compounds are to be synthesized, screened and tested, the cost of which ranges from 0.5 to 5 million dollars.[1] The use of herbal medicinal products and supplements has increased tremendously over the past three decades with not less than 80% of people worldwide relying on them for some part of primary healthcare.[2] A medicinal plant is factually any plant which in one or more of its parts contains substances that can be used for therapeutic purposes or which are precursors for the synthesis of direct therapeutic agents.[3]

One amongst richest floras for herbal drugs in the whole world is seen in Brazil. *Alternanthera brasiliana* (L.) Kuntze of the family Amaranthaceae is a herbaceous plant commonly known as penicillin or Brazilian joy weed. It is a neotropical native species and grows with ease on poor and deforested soil. It is an ornamental as well as a wild medicinal plant. It is used therapeutically against inflammation, cough and diarrhoea in Brazilian popular medicine.[4] The extract of *A. brasiliana* leaves has antinociceptive effect, anti-microbial effect and antiviral activity against herpes simplex virus. Aqueous and ethanol extract of *A. brasiliana* leaves are able to block human mitogen induced lymphocyte proliferation without any toxic effect.[5,6] Even if local traditional healers have ethnomedical knowledge on the medicinal values of *A. brasiliana*, scientifical validation or authentication of the medicinal values of this plant and the mechanisms of its diverse pharmacological actions has not been done to a greater extend.

Ethnomedicinal uses of *alternanthera brasiliana*

The plant is used as an herbal agent particularly in the treatment of pain, inflammation, infections, cough and tumour growth in Brazil. The ethnomedicinal uses of the plant around the world include treatment of colds, grippes and headache and indigestion. In Bihar, *A.brasiliana* is used for night blindness, hazy vision, wound healing, diarrhoea, dysentery and post-natal complaints. It has also been employed as immune modulator, analgesic, antipyretic, antibacterial and to cure different diseases such as lymphocyte proliferation and gonorrhoea. Poultice of the herb is used for boils. The plant is utilized as galactagogue, cholagogue, abortifacient, febrifuge and diuretic. Ether extract of the plant has anti-ulcerative property.

Pharmacognostic features

Macroscopic description

Alternanthera brasiliana (L.) Kuntze, belonging to the family Amaranthaceae is a perennial, prostrate and branchy 7.5- 45.0 cm long herb having a circular to polygonal stem in transection. Branches 7.5- 45.0 cm long, glabrous, nodes are often villous in nature, leaves are opposite and attach to swollen nodes and long internodes. Leaves are 2.5-7.5 cm long even longer if grown in watery places, rather fleshy, sometime obscurely denticulate. Flowers inconspicuous, white, in colour appear as clusters. Seeds 1.25-1.5mm in diameter are sub-orbicular. The inflorescence occurs in cymes and are composed of hermaphrodite, actinomorphous and monocyclic flowers.

Characters	Leaf
Shape	Oval-Lanceolate
Size	10cm long & 4cm wide
Colour	Purple green on adaxial side &purple on abaxial side
Odour	No characteristic odour
Taste	Slightly bitter
Apex	Acute acuminate
Base	Cuneate
Phyllotaxy	Decussate
Margin	Slightly wavy
Surface	Membranous and hairy

Microscopic features

The leaf was fixed, freehand section taken and stained according to usual micro-techniques using10% NaOH solution as clearing agent, stained with Astra-blue and safranin (1% aqueous solutions). The leaves are simple, entire and purple in colour, having uniseriate epidermis, non-glandular trichomes coated by papillose cuticle. Anomocytic and diacytic stomata exists on the two sides of a leaf, i.e., amphistomatic. Dorsiventral mesophyll, eucamptodromous venation with collateral vascular bundles and druses is also present.

Leaf

In transection, the epidermis is uniseriate and is covered by cuticle. Anomocytic and diacytic stomata are seen on both abaxial face and adaxial surface. Stomata appears to be even with the other epidermal cells or slightly raised above the surface.

A number of pluricellular non-glandular trichomes, consisting of three to five cells in a series occur on adaxial and abaxial surfaces but prominent in the abaxial face. The trichome basal cells are nearly isodiametric, the other cells of the series are long coated with papillose cuticle.

Mesophyll

The mesophyll has dorsiventral organisation, consisting of one layer of palisade parenchyma and about four layers of spongy parenchyma, the latter occupying majority of the mesophyll. The chlorenchyma cell walls are coated by phenolic compounds and the parenchymatic cells contain amiloplasts. Idioblasts predominate in the palisade parenchyma. Minor collateral vascular bundles are seen in the mesophyll and are enclosed by a sheath of parenchymatic cells.

Midrib

The transverse section of midrib is biconvex in shape. The epidermis has same features of the blade and angular collenchyma is seen beneath it which is formed by five layers on the adaxial side and two layers on the opposite side. Collateral vascular bundles are embedded in the ground parenchyma. A narrow cambial zone can be identified.

Petiole

The transverse section of petiole, has plain-convex contour. Epidermis is uniseriate and consists of polygonal cells, few stomata and several non-glandular trichomes similar to the

leaf. A non-continuous ring of angular collenchyma occurs, consisting of two or three rows. Collateral vascular bundles varying from four to eight, are embedded in the ground parenchyma, having caps of non-lignified and thick-walled cells next to the phloem. A cambial zone is seen between the phloem and the xylem. Idioblasts along with druses and phloem cell walls impregnated with phenolic compounds are also seen.

Stem

In secondary growth, the stem shows circular shape in transection. The epidermis is similar to the petiole. Chlorenchyma and angular collenchyma strands are alternate, and the cortex is bound internally by a parenchymatic sheath containing amiloplasts. The first cambium in the vascular cylinder forms phloem centrifugally and xylem centripetally. Xylem cells are all lignified, the tracheary elements may be solitary or in radial multiples. Next to the phloem, strands of perivascular fibres are present in different stages of lignification. Vascular bundles are seen in a bipolar position in the pith. Concentrical arcs of extra-cambia occur near the caulinar base and differentiating phloem outside and xylem inside Idioblasts with druses are found in the cortex and in the pith

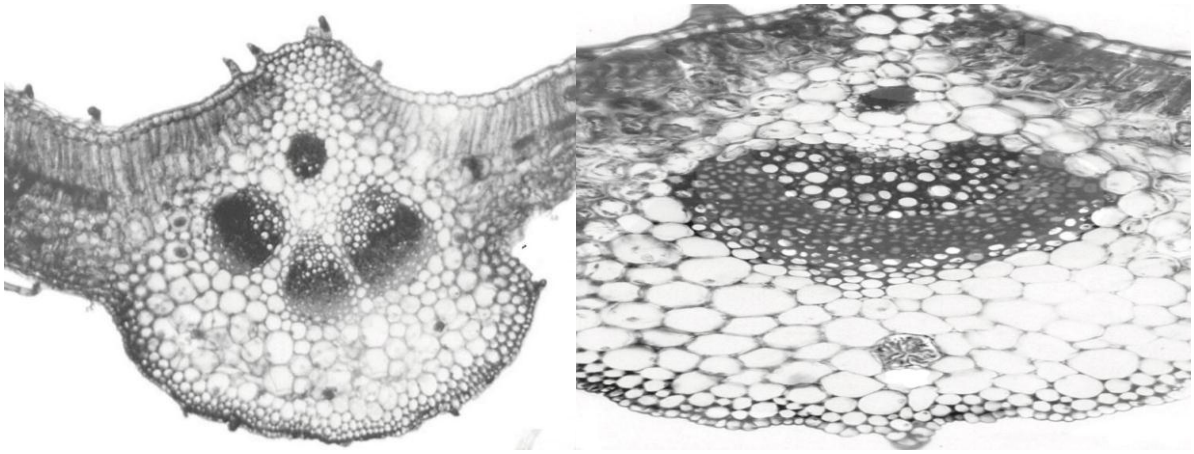

Figure: 1) *Alternanthera brasiliana*- midrib. 2) Transverse section of the lower third, exhibiting variable number of vascular bundles.

Phytochemical studies

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 is responsible for antioxidant property as they have the ability to scavenge free radicals due to their hydroxyl groups.

Elemental analysis

Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES) is one of the most common techniques for elemental analysis. Advantages of this technique include high specificity, multi element capability and good detection limits. Elemental analysis indicated the presence of macro, micro and other essential elements. Calcium, potassium, magnesium, phosphorus, nitrogen, carbon, sulphur and hydrogen were detected in appreciable levels. Elements like copper, zinc and sodium were present in much lower quantities. Carbon is found to be the element with highest concentration and accounts for 384.7mg/g followed by H 59.2mg/g, N 47.8mg/g and K 21.1mg/g respectively. Carbon, hydrogen and nitrogen are basic elements important for living organisms.

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.[7] Stigmasterol, lanosterol, β-sitosterol, a saturated aliphatic ester, and a saturated ester are also reported to be present. [8] Bioassay-guided fractionation was carried out to identify compounds responsible for the antiproliferative effect on lymphocytes on water-soluble phase of an ethanolic leaf extract.

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-Orobinobioside (4), kaempferol 3-Orutinoside-7-O-α-Lrhamnopyranoside (5) and kaempferol 3-O-rutinoside (6).[7]

Alternanthera brasiliana contains mainly 3-O-robinobioside derivatives of kaempferol and quercetin. The kaempferol skeleton was present in four of the six flavonoids isolated.

Further glycosylation was observed at C-7 for 1, 2 and 5. Only flavonoids (5, 6) showed a rutinosyl moiety at C-3. This shows that the 1→6 galactopyranosyl rhamnopyranosyl linkage is prominent in the *A. brasiliana* flavonol glycosides. Thus, it was identified that Kaempferol 3-O-robinobioside and 3-O-rutinoside inhibited lymphocyte proliferation. The anti-

inflammatory property can be attributed to the effects of flavonoids on T-cell function, thereby contributing to the medicinal properties of *Alternanthera brasiliana.*

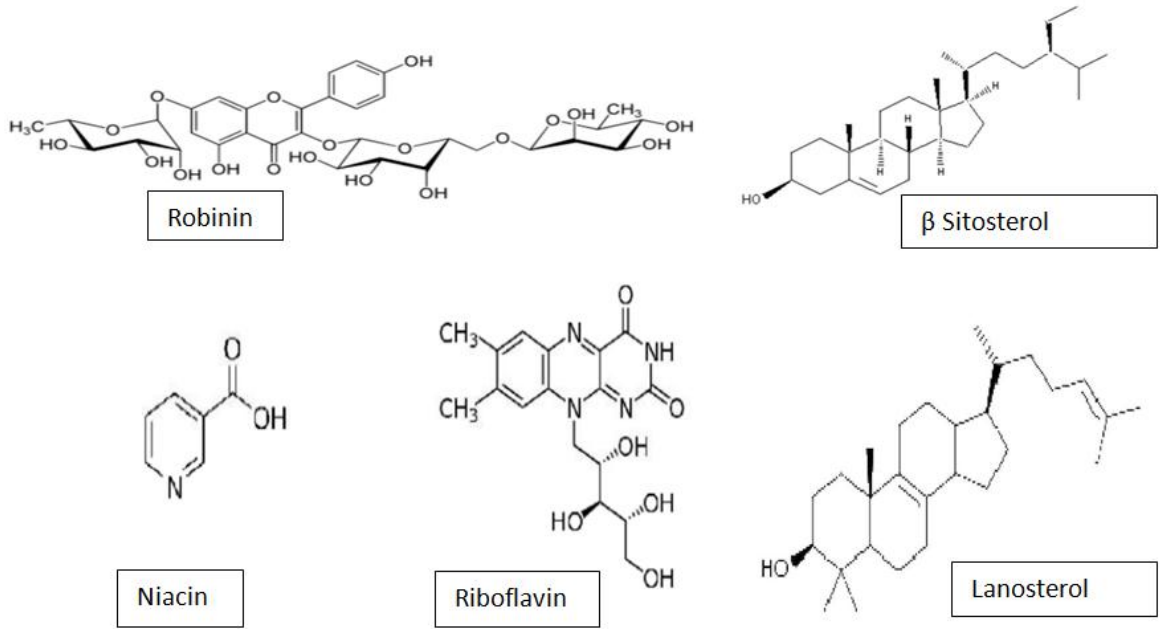

Figure 3: Structures of some phytoconstituents isolated from *alternanthera brasiliana.*

Pharmacological studies

Effect on lymphocyte proliferation in human

Alternanthera brasiliana (L.) Kuntze leaf extract yields six di- and triglycosyl kaempferol and quercetin derivatives which 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. These structures were elucidated based on the 1H- and 13C-NMR data. Kaempferol 3-O-robinobiosides and kaempferol 3-O-rutinoside significantly inhibited the human lymphocyte proliferation in vitro to a greater extent (IC50= 25 µg mL-1).[9]

Wound healing activity

Wound healing activity of methanolic leaf extract of *Alternanthera brasiliana* was evaluated in Sprague Dawley rats using Chorioallantoic membrane (CAM) model in comparison to the control group, percent contraction of wound in *Alternanthera brasiliana* (5% w/w) treated group was found to be significantly higher. Methanolic extract of *Alternanthera brasiliana* significant increase angiogenesis and tensile strength.[10]

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.[11] Two chemical nociception models in mice were used to analyse the methanolic extracts of *Alternanthera brasiliana* (L.) Kuntze plantlets cultured under different spectral quality of lights.

The plantlets developed under blue and white light treatments showed a highest biomass yield.Analgesic effect were evaluated using methanolic extracts obtained from *A. brasiliana* growing under different lights in comparison to 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.[12]

Antibacterial activity

The whole plant of *Alternanthera brasiliana* (L) Kuntz shows antibacterial activity, and the plant used in bronchitis and asthma.[13] 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.[14]

Antioxidant activity

Alternanthera brasiliana ethanolic leaf extracts antioxidant potential was carried out by determining the concentration of phenols in the extract as well as using 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical-scavenging, iron (II)-chelating, nitric oxide radical-scavenging, ferrous sulphate and carbon tetrachloride induced lipid peroxidation assays. Results of the assays were compared to that of the standard anti-oxidant -ascorbic acid and it indicates that the ethanol extract of the leaves of *A.brasiliana* is rich in natural anti-oxidants.[15]

Neuropharmacological activity

The study was conducted to evaluate ethanolic leaf extract of the plant for novelty-induced behaviour, anxiety, and convulsion in mice. The acute toxicity (LD50) was determined through oral (p.o.) and intraperitoneal (i.p) routes. ELE (250, 500 and 1000 mg/kg, p.o.) was

evaluated for novelty induced behaviours, anxiolytic, sedative and anticonvulsant activities. The study revealed that ethanolic leaf extract of *A. brasiliana* on the central nervous system is stimulatory; possess moderate anxiolytic activity but lack anticonvulsant activity.[16]

Antitumour activity

A study was carried out to evaluate the antitumor activity of the ethyl acetate extract of the *Alternanthera brasiliana* (EAAB) against Ehrlich ascites carcinoma (EAC) in Swiss albino mice. Anticancer activity of EAAB was evaluated at the doses of 200 and 400 mg/kg. Extract was administered for 14 consecutive days after induction of cancer. Half of the mice were sacrificed after 24 h of the last dose and 18 h of fasting, and the rest were kept alive for assessing increment in life span. Tumour volume, viable and non-viable tumour cell count, tumour weight, haematological and biochemical parameters of EAC bearing host was assessed to evaluate the antitumour potential of the extract and it was concluded that EAAB has potent dose dependent antitumor activity.[17]

Antinociceptive activity

Methanolic extract of leaves of *Alternanthera brasiliana* Kuntz. was tested for its antinociceptive activity in peripheral and non-narcotic models like acetic acid induced writhing syndrome test and narcotic analgesic models like tail flick and hot plate test. The methanolic extract of *Alternanthera brasiliana* when administered produced significant ($P<0.01$) analgesic activity in acetic acid induced writhing syndrome. In the hot plate analgesic test and the tail flick test, *A. brasiliana* treated the reaction time (in sec) increased dose dependently and was significantly ($P< 0.01$) higher in comparison to the control.[18]

Antifungal activity

Seeds of four bambara nut (Vigna subterranea) cultivars were tested for seed borne *mycoflora. phytopathogenetic fungi viz: Aspergillus niger, Aspergillus flavus, Aspergillus clavatus and Alternaria alternata* were isolated from the above samples.The percentage of fungal incidence on seeds of four cultivars ranged from 40% to 75% with cream white having the highest percentage incidence, while red nut had the least. The different percentages of fungal infection on seeds by the isolated fungi were equally evaluated and was found to range from 0.00 – 9.25%. The fungitoxic effects of the aqueous leaf extracts of *Alternanthera brasiliana* to control the radial mycelia growth of the isolated fungi was evaluated at different concentrations (10%, 20%, 30% and 40%). Results showed higher retardation of vegetative growth at 40% concentration. This study has revealed the potential of botanicals in the

control of seed– borne mycoflora of bambara nut in storage caused by *Alternaria and Aspergillus*. [19]

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