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PHYTOCHEMICAL AND PHARMACOLOGICAL ACTIVITIES OF AN EUPHORBIAN HERB, *SEBASTIANIA CHAMAELEA* (L.) MUELL. ARG.

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ABSTRACT

Sebastiania chamaelea Muell. Arg is a perennial herbal medicinal plant of family Euphorbiaceae and it is the only species of this genus represented in India. It is commonly found as forest undergrowth and also in cultivated lands. Based on folklore uses, the decoction of the plant in ghee is given as tonic and applied to the head in vertigo. Juice of the plant is astringent and is used as a remedy for syphilis and diarrhoea. Following the above folk claims for cure of vertigo, syphilis and diarrhoea, phytochemical and biological evaluation was carried out to test efficacy of the plant scientifically. Based on ethnobotanical data obtained from Nigerien and Senegalense traditional healers *S.chamaelea* istraditionally used to treat malaria. The studies revealed presence of various phytochemical compounds and some notable \ pharmacological activities of the plant such as antibacterial, antifungal, antioxidant, anthelmintic, antidiarrhoeal and antidiabetic activities, presented in this review such that the potential use of the plant in pharmaceutics can be evaluated. The present review is an attempt to highlight phytochemicals, pharmacolological as well as tissue culture reports on *Sebastiania chamaelea* Muell. Arg.

KEYWORDS: *Sebastiania chamaelea*, Phytochemicals, Folklore uses, Pharmacological activity.

INTRODUCTION

The plant kingdom has been the best source of remedies for curing a verity of disease and pain. The drug discovery industry is equally dependent on natural products for new

medicines.[1] Mainly because existing therapies exhibit many side effects that results in the recall of drugs, bringing huge losses to the pharmaceutical industries. Recently there has been a tremendous increase in the use of plant based health products in developing as well as developed countries resulting in an exponential growth of herbal products globally. According to the WHO more than 80% of the world's population relies on traditional herbal medicine for their primary health care.[2] Plants continue to serve as possible sources for new drugs and chemicals derived from various parts of plants.[3] However, due to over population, urbanization and continuous exploitation of these herbal reserves, the natural resources along with their related traditional knowledge are depleting day by day.[4]

In the present era of drug development and in discovery of newer drug; molecules of many plant products are evaluated on the basis of their traditional uses. One of the many plants which are being evaluated for their therapeutic efficacies is *Sebastiania chamaelea* which is commonly known as bapanabooraku (Telugu). Leaf decoction of *S.chamaelea* whole plant in ghee is given as tonic and applied to the head in vertigo. The juice of the plant is astringent and is used as a remedy for syphilis and diarrhea.[5,6] *S. chamaelea* possess 77.5% free amino acids, argenine with 60% of the free amino acids. The existence of necessary amino acids in *S.chamaelea*, had obviously promoted the role for its medicament activity.[7] The present review will possibly help to bridge between folklore claims and modern theory on *S. chamaelea* and also pin points unexplored potential of it.

CLASSIFICATION

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Sub.class: Magnoliidae

Order: Malphighiales

Family: Euphorbiaceae

Genus: *Sebastiania*

Species: *chamaelea*

Botanical Name: *Sebastiania chamaelea* (L). Muell. Arg.

DISTRIBUTION

Widespread in Asian countries like India, Sri Lanka, Vietnam and South China, the Solomon Islands and North Australia, Malay Peninsula (Thailand, Malaysia, Singapore), Sumatra, Java, Borneo (Brunei, Sabah, Sarawak) and Africa.

HABITAT & ECOLOGY

Found on beaches, sandy sites, roadsides and waste places, also on lateritic outcrops, dry dipterocarp forest, grass fields, and open woodland, often gregarious. Soil: sandy, alluvial and lateritic ground. Altitude from sea level up to 300 m. Flowers and fruits observed round the year, but particularly in the rainy season. The plants which grow under the shade appear green in colour without any red colour tinge.

Figure 1: Whole plant of *Sebastiania chamaelia.*

MORPHOLOGICAL CHARACTERS

A monoecious, erect to sprawling annual to perennial herb or shrub (**Fig.1)** up to 0.5 -1 m tall with slender stems. Leaves alternate, simple, almost sessile; stipules ovate, small; leaf blade linear- lanceolate, 3-6 cm × 0.8 mm, base cuneate, apex obtuse, margins finely toothed, short-hairy beneath. Inflorescence a small, terminal or leaf- opposed spike, most of the flowers male with 1-2 female flowers at base; bracts with 2 large glands at base. Flowers unisexual, regular, sessile, sepals 3, ovate, greenish yellow, petals absent, disc absent, male flowers with 3 free, shortly exerted stamens; female flowers with superior ovary, glabrous, 3- celled, styles 3, free. Fruit 3-lobed capsule 6 mm long, with 2 lines of excrescences on each lobe, 3-seeded, blackish or grey.

PHYTOCHEMICAL PROPERTIES

Preliminary phytochemical screening of the extracts revealed the presence of Phenols, Flavonoids, Tannins, Steroids as main constituents along with Glycosides, Alkaloids, Lignins and Saponins. Presence of Phenolic compounds supports its antimicrobial activity and also the herbal usage against diarrhoea.

Bioassay guided fractionation of aqueous extract of these plants enabled the isolation and identification of ellagic acid as the main compound responsible for their antiplasmodial activity. Together with ellagic acid, other derivatives belonging to different chemical groups were isolated but showed moderate antimalarial activity; gallic acid, brevifolin carboxylic acid, protocatechuic acid, corillogin, rutin and 3,4,8,9,10- pentahydroxy-dibenzo (b,d) pyran-6-one.

PHARMACOLOGICAL PROPERTIES

ANTIBACTERIAL ACTIVITY

The antibacterial activity of the methanolic leaf extract of *S. chamaelea* against pathogenic bacteria like *Bacillus subtilis and Staphylococcus aureus*, *E.coli* and *Pseudomonas aeruginosa* showed concentration dependant inhibition of *Bacillus subtilis*, *S. aureus*, *P. aeruginosa and E. coli*.

ANTIFUNGAL ACTIVITY

The aqueous, methanol, ethanol, chloroform extracts and fractions of aqueous extract eluted from coloumn chromatography were analyzed for their antifungal activity by agar well diffusion method against fungal species *Candida albicans* (ATTC-10231) and *Aspergillus niger* (ATCC-16404). It was observed that ethanol, methanol and aqueous extracts showed significant antifungal activity than chloroform extract. Fraction-A of aqueous extract was more effective than fraction-B against the same fungal species. Minimum inhibitory concentration (MIC) of *Candida albicans* for aqueous, methanol and ethanol extracts was 1.42, 3.15, and 3.31 in mg/ml; whereas *Aspergillus niger* shows 1.38, 1.44 and 1.38 mg/ml. Chloroform extract was not showing any activity when compared with standard drug Nystatin at 10 mg/ml.

ANTIOXIDANT ACTIVITY

It has been reported that numerous plant extracts have antioxidant activities to scavenge free radicals. *Sebastiania chamaelea* (Euphorbiaceae) leaf water, methanol, ethanol and

chloroform extracts were screened for antioxidant activity by DPPH- free radical scavenging assay and reducing power assay. The DPPH scavenging assay results show that the IC_{50} values of *S. chamaelea* aqueous, methanol, ethanol and chloroform extracts are 100.90 µg/ml, 519.47µg/ml, 1065.65 µg/ml and 1403.80 µg/ml respectively. The reducing power of all the extracts increases with increase of concentration. The total phenolic content of aqueous, methanol, ethanol and chloroform extracts as 235±5.0, 193.3±5.0, 170±10.0 and 41.66±8.33 µg/g and the total flavonoid content as 210±0.0, 180±0.0, 170±0.0 and 120±0.0 µg/g respectively. The results indicate that *S. chamaelea* aqueous extract clearly has effective antioxidant effect in relation to the total phenols and flavonoid content.

ANTHELMINTIC ACTIVITY

Leaf aqueous, methanol, ethanol and chloroform extracts of *Sebastiania chamaelea* were screened for their anthelmintic activity against *Pheretima posthuma*, with 50, 100, 150 and 200 mg/ml concentrations. Each extract was tested in the bioassay, which involved determination of time of paralysis and time of death of the worm. *Albendazole* (25 mg/ml) was used as standard reference and distilled water as control. All the four tested extracts exhibited significant anthelmintic activity in dose dependant manner, while chloroform extract shows high anthelmintic activity when compared with other extracts, which is almost equal to the standard drug. Preliminary phytochemical screening of aqueous, ethanol, ethyl acetate and chloroform extracts revealed the presence of phenols, flavonoids, steroids, tannins in higher quantities and glycosides, and terpenoids in low quantities. While lignins are present only in ethanolic extract. The anthelmintic activity is may be due to the presence of alkaloids which are present in chloroform, ethanol and ethyl acetate extracts.

ANTIDIARRHOEAL ACTIVITY

Antidiarrhoeal activity was undertaken with aqueous and methanolic extracts of *S. chamaelea* leaves by using castor oil induced diarrhoea and enteropooling model in wistar albino rats at two dose levels (100 mg/ml and 200 mg/ml). The percentage inhibition of diarrhoea of aqueous and methanol extracts at the dose of 100 mg/kg and 200 mg/kg was found to be 72.42%, 75.87% and 75.87%, 89.66% respectively when compared to that of the standard drug atropine, showing 34.49% of inhibition of diarrhoea, which was lesser than the plant extracts. Aqueous and methanol extracts at the dose of 100 mg/kg and 200 mg/kg of b.w produced 17.52%, 35.60% and 43.51%, 63.85% respectively when compared to standard drug atropine, showing 52.55% inhibition of weight of intestinal content, which was lesser to

that of the plant extracts. Both the extracts showed dose-dependent and significant antidiarrhoeal activity by castor oil induced diarrhoea and reduction in enteropooling as well. The plant extracts showing the presence of tannins, which may form pritien tannate, cause an astringent action and may resulted into effective antidiarrhoeal activity. Hence this study supports the traditional claim of *S.chamaelea* as an antidiarrhoeal drug in the Indian system of medicine.

ANTIDIABETIC ACTIVITY

Aqueous extract and methanolic extracts of leaves of *Sebastiania chamaelea* were used to test their antidiabetic activity in alloxan induced diabetic albino rats. Aqueous and methanolic extracts are given to the alloxan induced rats at the concentration of 300 mg/kg body weight in different groups of 6 diabetic rats each orally once a day for 21 days. Glibenclamide is also given to another group to support the results at the concentration of 10 mg/kg body weight orally once a day for 21 days. Diabetic control received vehicle. Body weight showed significant increase ($p< 0.01$) after 21 days of treatment with herbal extract when compared with the control. Blood glucose level on 21st day of treatment become significantly low ($p< 0.01$). Oral administration of aqueous and methanol extract of *S.chamaelea* for 21 days had shown a significant ($P<0.01$) reduction in cholesterol (TC), very low density Lipoprotien-Cholesterol (VLDL-C), LDL-Cholesterol, Triglycerides (TG) and an elevation in HDL-Cholesterol. Diabetic control rats had elevated levels of cholesterol, VLDL-C, LDL-C, TG and decreased HDL-cholesterol. Histopathological studies showed regeneration of tissues like liver, pancreas and kidney.

The various groups of secondary metabolites present in *S. chamaelea* extracts may act separately or synergistically cause the hypoglycaemic effect. For instance, flavonoids are reported to regenerate the damaged pancreatic β-cells in diabetic animals.[8] Quercetin supplementation promotes regeneration of the pancreatic islets and increases insulin release in alloxan induced diabetic rats.[9] The inhibitoty effect of some flavonoids on C- AMP-Phosphodiesterase activity that eventually stimulates the insulin secretion reduces blood glucose concentration.[10] Myricetin, a naturally occurring flavonoid was found to lower blood glucose through improved glucose utilization in diabetic animals. Recently, some natural compounds including flavonoids have reported to activate peroxisome proliferators activated receptors ($PPAR_s$).[11] Polyphenolics such as tannins and saponins from several

plant extracts also shown to reduced blood glucose level through inhibition of α – amylase and sucrose from the intestine.[12,13]

The hypoglycaemic action of the extract of herbal plants in diabetic rats may be possible through the insulinomimictic action or by other mechanism such as stimulation of glucose uptake by peripheral tissue, inhibition of endogenous glucose production or activation of gluconeogenesis in liver and muscles.[14] The antidiabetic activity of the aqueous and methanol extracts used in the present investigation may be possible through the mechanism as reported by Burcelain *et al* (1995). This is an interesting finding and suggests that *S. chamaelea* leaves may have antioxidant or free radical scavenger properties in preventing these changes.

IN-VITRO AND *IN-VIVO* ANTI MALARIAL ACTIVITY

Plant extracts were prepared with different solvents and tested both, invitro on several strains of *Plasmodium falciparum* and *invivo* to evaluate their antiplasmodial properties and to isolate their active principles with IC_{50} values around 6.5 µg/ml and no significant cytotoxicity. The whole plant aqueous extract from *S. chamaelea* showed the best invitro results. Invitro potentiation assays showed strong synergistic activity of *S. chamaelea* extract with the antiplasmodial drug chloroquinone on chloroquine-resistant *P. falciparum* strain W^2 –Indochina.[15]

PHYTOCHEMICAL ANALYSIS OF INVITRO CALLUS CULTURE

The present study was aimed to carry out preliminary phytochemical and antibacterial activity of six different solvents extracts from leaf and leaf derived callus of *S. chamaelea*. The maximum percentage of callus mass was achieved in modified MS medium supplemented with different concentration of 2, 4 – D (2.0, 3.0, 4.0 and 5.0 mg/l). *In vitro* antibacterial activity of leaf and callus extracts were tested against 12 bacterial cultures by agar well diffusion method. The acetone, methanol and ethyl acetate extracts of leaf and leaf derived callus show maximum inhibitory effect. The preliminary phytochemical analysis reflects the presence of phenolic compounds, carbohydrate, alkaloids, phytosterols, fats and oils, terpenoids. The result highlights among two extracts, leaf extract show negligible activity than callus extracts. The present study conclude that *in-vitro* raised plants can be utilized for isolation of antimicrobial drugs than wild plants.[16]

CONCLUSION

S. chamaelea Muell. Arg. belongs to Euphorbiaceae family which has significant traditional uses, some of them have been experimentally established. The present article reveals the traditional uses, pharmacological properties and chemical constituents present, which can be useful information for further study of this plant to isolate, purify, and characterize the active constituents responsible for the activity.

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