

aAn overview of pharmacological efficacy and chemical moieties of *Strobilanthes ciliatus* Nees. (Acanthaceae)

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Abstract - The expensive modern drugs have been replaced by medicinal plants these days. *Strobilanthes ciliatus* Nees & Meyen, as called "Sahachara" is mainly used in the Indian system of drug and medicine and has shown biochemical activities that are – anti-microbial, anti-cancerous, anti-inflammatory, analgesic, hepatoprotective, antidiabetic. In ayurvedic preparation roots and leaf of the *Strobilanthes* is a main ingredient which removes of inflammation and pain, compounds such as betulin, lupeol, stigmasterol, stigmasterol glycosides etc. has been reported from the stem extract. The major component present in the plant's various parts is lupeol, which has a broad pharmacological potential. The phytoconstituents or the phytochemicals along with biological activities contribute for the medicinal importance of this plant. This review paper tends to cover information available on various studies of medicinal values and chemical constituents of *S. ciliatus* Nees & Meyen.

Keywords: Hepatoprotective, Phytochemistry, Lupeol, Analgesic

Comment [S1]: Please write correct botanical name as *Strobilanthes ciliata* Nees. Correct everywhere ..

Please also mention the synonyms in manuscript *Goldfussia zenkeriana* Wight ; *Nilgiranthus ciliatus* (Nees) Bremek.; *Nilgiranthus warreensis* (Dalzell) Bremek. ; *Strobilanthes parviflora* Bedd.; *Strobilanthes warreensis* Dalz. <https://powo.science.kew.org/taxon/um:lsid:ipni.org:names:55601-1>
Also mention the other common names in manuscript.

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INTRODUCTION

Genus *Strobilanthes* Blume is a perennial flowering herb or shrub and it is a second largest genus in the family—Acanthaceae with 350 species in Tropical Asia out of them 150 species are present in Indian subcontinent. Total 46 species are native to India. *Strobilanthes* is the second largest genus. In different traditional systems of Indian medicine, many plants are used. Chemical substrates which produce physiological actions inside the human body is are the medicinal value of the plant. Medicinal plants are low cost alternative for modern expensive medicine due to which their use has been increased. [2][4].

Genus *Strobilanthes* is a flowering perennial herb and shrub with almost 350 species, out of which 46 are native to India. Genus *Strobilanthes* Blume *Strobilanthes* contain chemicals or phytochemicals such as flavonoids, phenolics, fixed oils, terpenoids, phytosterols, proteins, saponins, glycosides, carbohydrates, and alkaloids. *Strobilanthes*, stem and leaf show presence of carbohydrates, phenolic, fixed oils, phytosterols, flavonoids, and terpenoids. In all the species of *Strobilanthes*, phytosterols and terpenoids are present. Most of the species of *Strobilanthes* contain flavonoids, phenolics, and carbohydrates. [4]

Strobilanthes (family—Acanthaceae). Acanthaceae —family of dicotyledonous flowering plants which have about 250 genera and 4000 species. Due to the presence of phytochemicals Acanthaceae family has high medicinal value. Most species of this family are shrubs, tropical herbs or vines twining few of them are epiphytes. Temperate region contain only few species of this family. [7]

Due to ~~test recent results of~~ and research carried out in the world, knowledge about properties of medicinal plants is continuously growing all over the world. *Strobilanthes* s *Blume* species can be uses as an alternative to allopathy in many cases. The whole plant of *Strobilanthes* *Blume* species is recognized as valuable medicine/drug used in ancient – traditional medicine. Only few species of ~~genus—~~*Strobilanthes* *Blume* have has been studied for their chemical constituents / phytochemicals. [9]

Strobilanthes ciliatus belonging to genus *Strobilanthes* is a medicinally potent plant which is attracting a lot of researchers and scientist because of its numerous amounts of pharmacological activities and secondary metabolic activities.

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S. ciliata Nees ~~*S. ciliatus*~~ has a strong aroma and has been used in ayurvedic medicine/drug ~~Also~~ also in Indian medicine system. In ayurvedic preparation plants are important ingredient. The plant has also shown effects on neurological disorders. [13]

The ~~plant~~ roots of *S. ciliata* Nees are thermogenic, sweet, bitter, diuretic, emollient, diaphoretic, febrifuge, tonic, and expectorant. ~~The~~ Its bark and leaf of ~~*Strobilanthes ciliatus*~~ are expectorant, diaphoretic, depurative, and febrifuge. They cure fever, whooping cough, leprosy, leukoderma, inflammation, and pruritis. ~~The~~ Its leaves of ~~this plant~~ are externally applied on lumbago, gout and joint pain. Leaves of ~~this plant~~ are used in treatment of dropsy, jaundice, urinogenital tract and rheumatism. The root, seeds, stem, and leaves of this plant has enormous number of therapeutic effects such as chest congestion, jaundice, bronchitis, odontalgia, diabetics, lumbago, sciatica, limping, diuretic, diaphoretic, and rheumatism treatment [1].

Terpenoids, flavonoids, carbohydrates, phytosterols, and tannins are main phytochemicals present in *S. ciliata* Nees ~~this species~~. Phytoconstituents such as flavonoids, flavanols, lipids, and tannins were quantified ~~in~~ *S. ciliata* Nees. Major constituent found in this species is lupeol which exhibit broad spectrum of biological activity like antitumor, antiprotozoal, antimalarial, and anti-inflammatory. [6]

Comment [S3]: Please give here original photocopy of *S. ciliata* Nees.



<https://www.flowersofindia.net/catalog/slides/Lesser%20Kurinji.jpg>

Image 1: Taxonomic classification

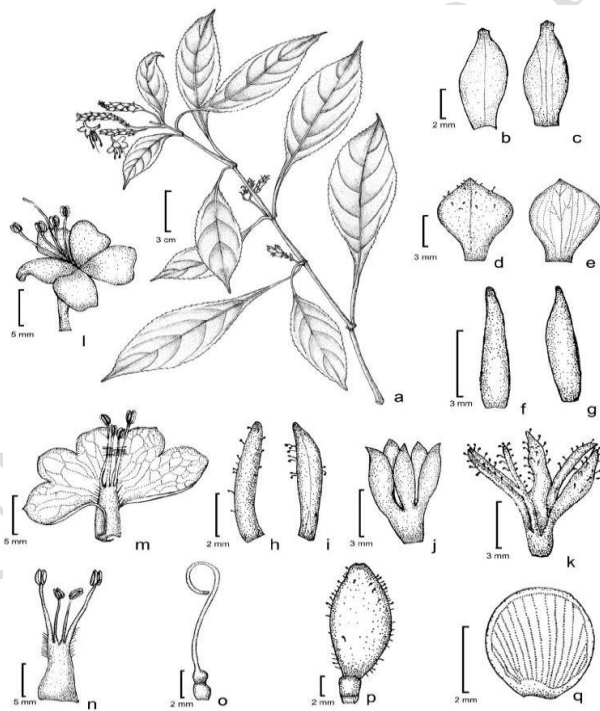
Kingdom - Plantae

Subkingdom - Phanerogamia
 Division - Angiosperm
 Class - Eudicots
 Subclass - Asterids
 Order - Lamiales
 Family - Acanthaceae
 Genus - *Strobilanthes*
 Species - *Strobilanthes ciliatus*

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Figure-

Strobilanthes ciliatus -



Comment [S5]: This illustration of *S. ciliata* does not need here. If you want to add here please first of all take permission from author and from Journal editor. And also mention in manuscript. Otherwise it is Plagiarism case of photocopy.

FIGURE1 – (a) twig with the flower, (b),(c) Flower- bract (ventral and dorsal side), (d),(e) fruit- bract (ventral and dorsal side), (f),(g) flower- bracteole (ventral and dorsal side), (h),(i) fruit- bracteole (

ventral and dorsal side), (j) sepal - flower, (k) sepal - fruit, (l) petal, (m) petal with the stamen, (n) stamen, (o) carpels, (p) Pod/capsule, (q) seed. [14]

General Morphology of *S. ciliata* Nees - Prominent, often fimbriate, nodes jointed, leaves opposite, simple, lanceolate, serrate, attenuate at base, glabrous, apex acuminate. 4 seriate flower, pale or white, purple dense spikes. Capsule are ciliate and oblong. Calyx – 5-6.5 mm long, segments unequal, acute at apex, linear to lanceolate, glabrous, few glandular hair present. This plant produces fruits and blooms (flower) once in a year, during December–March [1].

MEDICINAL ASPECT

Recent investigation carried out of *Strobilanthes ciliata* Nees on this plant proves and supports the pharmacological potential of this plant as anti-inflammatory, antimicrobial, antioxidant, analgesic, anti-diabetic, anti-cancerous by using suitable *in vitro* and *in vivo* methodologies [1].

Anti-Microbial Activity

Antimicrobial activities of the *Strobilanthes ciliata* Nees plant also shows antimicrobial activities. Its extract against different strain of fungi and bacteria have been proven by reports. To study ethanolic and acetone extract for anti-microbial property, study was conducted with 3 strains of bacteria *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, one fungal strain *Aspergillus* through method of disc diffusion. In this method root and stem extract resulted in activity (medium) against the strains. Chloroform, petroleum, ether, and aq. extract on the leaf of *Strobilanthes ciliatus* was evaluated against various types of fungus and bacteria such as- *S.aureus*, *B.subtilis*, *E.coli* (bacterias); *A.niger*, *C.albicans* (fungus). For the fungal stains *Monascus purpureus*, *Microsporium gypseum* and *Trichophyton rubrum* were used. [3]

Antimicrobial activity was assessed by determination of MIC and disc diffusion by serial dilution methods using clotrimazole- 10mg and ciprofloxacin- 5mg. extracts of petroleum ether showed highest activity against *Corynebacterium*, *Klebsiella*, and *Escherichia coli*. [12]

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Antiviral Activity

Study (preliminary) performed using Chloroform and petroleum ether extract of the *Strobilanthes ciliata* Nees. leaf show antiviral effect towards HSV-I and HSV-II against the 10TCID₅₀, 2TCID₅₀ complex doses. According to this, *Strobilanthes cusia* which belongs to the same genus exhibit good antiviral potential against RNA viruses. Weak antiviral potential is shown by lupeol in many studies. Lupeol has served as a lead drug for ages. In *Strobilanthes cusia* root the lupeol extract isolated shows an EC₅₀ – 11.7 μM against HSV-1 and also shows inhibition (100%) of virus plaque. Betulinic acid has shown better activity against HSV-1, reducing plaque formation, it is known for anti-HIV activity. [1]

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Hepatoprotectivity

The methanolic extract of bark of *Strobilanthes ciliata* Nees. show hepatoprotective activity against paracetamol induced toxicity in mice. Dose of about 2.5g/kg of paracetamol was induced orally to damage the liver. The experiment was conducted on animals by segregating them into five groups I, II, III, IV, V. through this experiment conducted the hepatoprotective activity of *Strobilanthes* bark was proven. [15]

Significant reduction in levels of SGOT, ALP and SGPT was shown through the Biochemical studies when compared to treatment group and paracetamol control group showed great increase in total serum protein level. Examination (histopathological) of animal liver tissue used for experiment showed hepato-protective activity. [1]

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Antidiabetic Activity

To show the antidiabetic activity of *Strobilanthes ciliata* Nees. ~~*Strobilanthes ciliata*~~ the alcoholic and aqueous extract of the whole plant of ~~*Strobilanthes ciliata*~~ was used to conduct study on streptozotocin-nicotinamide induced experimental rats. The aqueous solution extract showed lower level of blood sugar when they were judged on the basis of normal rats. Experimental rats were divided into groups and different parameters were used such as oral glucose tolerance, acute toxicity, normoglycemic study was performed before going for antidiabetic screening. Using α - amylase and α - glucosidase inhibition assay evaluated the whole plant for the antidiabetic activity of the ethanolic extract. The experiment showed α - amylase inhibitory activity is less than the α - glucosidase inhibitory activity is high. The mild/lower inhibition of α - amylase and strong/high inhibition of α - glucosidase is an effective treatment for type-2 diabetes. [1]

~~*In vitro* study of *Strobilanthes ciliata* Nees. *Nilgiranthus ciliatus* belonging from the same family as that of *Strobilanthes ciliatus*, revealed that~~ ethanolic extract inhibition of α - glucosidase is higher than α - amylase inhibitory activity. This ~~study~~ confirms that *Strobilanthes ciliata* Nees. ~~*Nilgiranthus ciliatus*~~ show therapeutic effect on type-2 diabetes. [6]

Comment [S10]: *Strobilanthes ciliata* Nees. And *Nilgiranthus ciliatus* (Nees) Bremek are the same plants.

Acute Oral Toxicity Studies

To evaluate the acute toxicity study of the extracts of *Strobilanthes ciliata* Nees. the plant was conducted on healthy Wistar albino rats and were divided into four groups of five each. Extract observed and administered through the oral gavage for about 4 hours to observe the change in behavioural and autonomic response that are as follows salivation, corneal reflex, urination, spontaneous activity, irritability. At the end of these study experiments results shows no death was seen/reported in the albino rats having about maximum dose of extract with oral route. Results of this experiments showed that the extract had no toxic effect and were safe for *in vivo* use. [1]

Anti-Inflammatory Activity

Experiment (acute toxicity study) was conducted on rats with ethanolic extract of aerial parts of *Strobilanthes ciliata* Nees. ~~*Strobilanthes ciliatus*~~, a dose of about 2000mg/kg was given for 14 days and no mortality was reported. *Strobilanthes ciliata* Nees. ~~*Strobilanthes ciliatus*~~ LD50 will be less than 2000mg/kg body weight. [10]

The ethanolic extract of *Strobilanthes ciliata* Nees. shows reduction in carrageenan depending on the dose cause paw edema in the rats. The lower paw edema of rats vol. better was the anti-inflammatory properties. This study showed that *Strobilanthes ciliatus* (ethanolic extract of aerial part) is effect as anti-inflammatory. [5]

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Anti-Cancerous Activity

Cytotoxicity of methanolic and acetone extract of *Strobilanthes ciliata* Nees. show great activity against EAC and DLA cells, the amount of dose of extract used is not mentioned. Cytotoxicity of extract of hydroalcoholic extracts of *Strobilanthes ciliata* Nees. ~~*Strobilanthes*~~ was evaluated against the MCF-7 through MTT assay. IC50 value of standard and extract was 3.3 μ g/ml and 3.68 μ g/ml. the study proved that cytotoxicity of extract of *Strobilanthes ciliata* Nees. ~~*Strobilanthes ciliatus*~~ show anti-cancerous activity.[5]

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Analgesic Activity

Analgesic activity (*in vivo*) was conducted on plant extracts of *Strobilanthes ciliata* Nees. through the method- tail clip. Dose- 100-200 mg/kg were used/evaluated against pentazocine dose – 5 mg/kg. Experiment conducted resulted in inhibition of tail clipping at different time intervals depending upon the dose, after 30 min increase in biting of tail clip mean latency was observed. The activity proved the analgesic property of the *Strobilanthes ciliata* Nees. ~~*Strobilanthes*~~ plant. [5]

Antioxidant Activity

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With the help of *in vitro* radical scavenging assay, antioxidant activity of *Strobilanthes ciliata* Nees. leaf ethanolic leaf extract was evaluated. The assay showed inhibition of [DPPH] activity depending on the dose with IC50 – 47.11µg/ml comparing to ascorbic acid IC50 – 50.11µg/ml. The *in vitro* assay at a dose of 100µg/ml at a dose depending manner also showed radical superoxide scavenging activity. The results show antioxidant activity from the ethanolic leaf extracts of the plant. [5]

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DNA Protective Effect

Comet assay showed that *Strobilanthes ciliata* Nees ethanolic leaves extract against H₂O₂ reduced DNA damage in lymphocytes (cultured). In the experiment four groups of cells were there group I-0.05% DMSO, II-500µg/ml H₂O₂, III- pre-treated with 60µg/ml of extract and 500µm H₂O₂, IV-60µg/ml of extract. The DNA damage caused by administering H₂O₂ was very low in cultured lymphocytes which was pre-treated with 60µg/ml- ethanolic leaves extracts. [1]

PHYTOCHEMICAL ASPECT

The phytochemical contents in *Strobilanthes ciliata* Nees. experiments conducted showed presence of various components of different types of chemical constituents such as lipids, tannins, flavonoids, flavanol, terpenoids, phytosterols, and carbohydrates etc. [8]

On the ethanolic leaf extract of *Strobilanthes ciliata* Nees plant GC-MS analysis was conducted the result showed presence of various chemical moieties in the extract of the plant. Lupeol which is a steroid and terpenoid, butelin, stigmasterol glycoside, stigmasterol was reported through, stem acetone extracts. [5]

FOURIER TRANSFORM INFRA-RED SPECTROSCOPY (FTIR)

FTIR peak values and functional groups in methanol extract of *Strobilanthes ciliata* Nees. *Strobilanthes ciliatus* Nees (*Bremek*) studies showed the presence of functional group such as aryl alkyl ethers, sulfate, alkane, silane, amine, carboxylic acid, alkyne, amides, ketone, lactans, aldehyde. Phytoconstituents present in the leaves of *S. ciliata* Nees. *Strobilanthes ciliatus* Nees (*Bremek*) if subjected to biological activity will give effective results for treatment of many ailments. The presence of functional groups could be responsible for various medicinal properties of *S. ciliata* Nees. *Strobilanthes ciliatus*. FTIR analysis is useful for the identification of bioactive compounds present in plant extracts. [11]

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CONCLUSION

This review paper focuses on the chemical constituents and medicinal value of *Strobilanthes ciliata* Nees. the plant *Strobilanthes ciliatus*. This article Present review shows scientific studies carried done on the this *S. ciliata* Nees. plant *Strobilanthes ciliatus* for its worldwide popularity for its medicinal uses in ayurvedic, traditional ancient medicinal system and therapeutic effect. *S. ciliata* Nees. *Strobilanthes ciliatus* has shown anti-inflammatory, antimicrobial, antioxidant, analgesic, antidiabetic, anti- cancerous properties. The bark and leaf of *S. ciliata* Nees. *Strobilanthes ciliatus* are expectorant, diaphoretic, depurative, and febrifuge. They cure fever, whooping cough, leprosy, leukoderma, inflammation, and pruritis. The leaves of *S. ciliata* Nees. this plant are externally applied on lumbago, gout and joint pain. Leaves of this plant are used in treatment of dropsy, jaundice, urinogenital tract and rheumatism. Various experimental results confiems The research carried upon this plant has shown *S. ciliata* Nees- it as a valuable source for various chemical compounds such as lipids, tannins, flavonoids, flavanol, terpenoids, phytosterols, and carbohydrates etc. This review paper gives a brief view on the phytochemical aspect and the medicinal efficiency of *S. ciliata* Nees the plant *Strobilanthes ciliatus* and may also be helpful for future development of medicine/drug from the plant.

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