Review Article

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PHARMACOGNOSTICAL, PHYTOCHEMICAL AND PHARMACOLOGICAL OVERVIEW OF *ACALYPHA INDICA* LINN. (EUPHORBIACEAE)

Ajai Franco SR [1]*, Vijaya Bharathi R [2], Radha R [3], Kirubavathi S [1], Avantikka E [1]

[1] Research Scholar, Department of Pharmacognosy, College of Pharmacy, Madras Medical College, Chennai, India

[2] Assistant Professor, Department of Pharmacognosy, College of Pharmacy, Madras Medical College, Chennai, India

[3] HOD, Department of Pharmacognosy, College of Pharmacy, Madras Medical College, Chennai, India

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***Corresponding author**

E-mail: ajaifranco72@gmail.com

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ABSTRACT

Acalypha indica is a plant species found on roadsides and riverbanks throughout India. Native to India and Southeast Asia, Acalypha indica is an evergreen shrub often used for ornamental purposes. As the world becomes increasingly aware of the benefits of plants, the future of *Acalypha indica* is looking bright. It is an essential medicinal species used extensively for treating patients in the Ayurvedic and Siddha systems of medicine. It is claimed to treat various health conditions and management of chronic diseases. Due to these therapeutic activities, researchers made several studies to evaluate the chemical composition and pharmacological activities produced by the plant. Flavonoids, cyanogenic glucoside (acalyphin), tannins, saponins, and pyranoquinolinone alkaloid (flindersine) are the major chemical constituents present in *Acalypha indica*. *In vitro,* and *in-vivo* studies have been carried out to confirm various pharmacological activities present in this plant. This includes antioxidant, anti-inflammatory, antimicrobial, anti-fertility, antivenom, wound healing effect and anti-diabetic activities. They are also used as diuretic, cathartic, anthelmintic and in treating psoriasis. Overall, the potential of *Acalypha indica* is vast, and its future looks promising. As research progresses, more and more medicinal and ornamental uses may be discovered. This review will summarise all the pharmacological activities registered by this plant and the phytochemicals present in *Acalypha indica.*

Keywords: *Acalypha indica,* Traditional medicine, Euphorbiaceae, Phytopharmacology.

INTRODUCTION

Acalypha indica is an important medicinal plant that has long been used in Ayurvedic and traditional medicines. The leaves stem, root and other parts have been used for various therapeutic purposes. It has recently attracted considerable attention due to its potential health benefits and many beneficial phytochemical constituents present in the plant.

Acalypha indica is an evergreen shrub typically growing 3-4 feet tall. It produces small white or yellow flowers in loose clusters in spring, followed by bright red fruits in summertime. The glossy leaves of this plant are characterized by their 3-lobed structure and reddish-bronze hue, giving them an ornamental appeal which makes them especially desirable for garden landscaping.

Phytochemicals are chemical compounds plants produce as defence mechanisms against environmental threats such as pests or diseases. In *Acalypha indica*, various bioactive components have been reported, including flavonoids, phenolic acids, saponins, alkaloids, terpenoids and tannins.[1]

The leaf extracts of *Acalypha indica* possess anti-inflammatory and antioxidant properties, which may be beneficial in treating a wide range of medical conditions, such as rheumatoid arthritis and other inflammatory diseases. Additionally, research indicates that stem extracts have analgesic properties, potentially reducing pain and discomfort associated with arthritis or other musculoskeletal conditions.[2]

Furthermore, the root extracts are rich in active compounds such as polyphenols which are known to possess antioxidant activity that can protect against cancer and other degenerative diseases. Research has shown that polyphenols can help protect against damage caused by oxidative stress, lower blood cholesterol levels and reduce inflammation. Moreover, root extract exhibits antibacterial activity, which may help fight bacterial infections like urinary tract infections or diarrhoea.

Synonyms

- *Acalypha bailloniana* Müll.Arg
- *Acalypha canescens* Benth., nom. nud
- *Acalypha bailloniana* Müll.Arg
- *Acalypha caroliniana* Blanco, nom. illeg
- *Acalypha chinensis* Benth
- *Acalypha ciliata* Benth., nom. nud
- *Acalypha cupamenii* Dragend
- *Acalypha decidua* Forssk

Vernacular Names

- English: Indian acalypha
- Tamil: Kuppaimeni
- Malayalam: Kuppigidda
- Bengali: Muktajhuri
- Gujarati: Vanchhikan
- Hindi: Kuppi
- Kannada: Kuppameni
- Marathi: Arittamunjariye
- Sanskrit: Kuppameni, Rudra
- Telugu: Kuppinata. [3]

Taxonomy

- Kingdom: Plantae
- Class: Angiosperms

- Order: Malpighiales
- Family: Euphorbiaceae
- Subtribe: Acalyphinae
- Genus: *Acalypha*
- Species: *indica*

Acalypha indica

***Acalypha indica* leaves**

***Acalypha indica* inflorescence**

Acalypha indica, commonly known as the Indian nettle, is a plant species native to Asia and parts of Africa. Due to its aesthetic qualities, *Acalypha indica* has become increasingly popular as an ornamental plant worldwide in recent years; it can be found growing in gardens in tropical climates as far south as Brazil and Mexico up through much of Europe, Australia and New Zealand. Although it prefers moist soil with total sun exposure when planted outdoors, it can thrive indoors with adequate watering.

Morphology

The plant is leafy, truncate, and has dentate connective anther, cuneiform with many nerve bracts and 6-8 mm diameter. This plant can grow up to 80- 100 cm in height. The leaves are 2.5-7.5 cm long and 2-2.5 cm broad ovate or rhomboid in shape and end as acute with crenate-serrate margin. The base is wedge-shaped or cuneate. The petioles are usually longer than the blade, slender, and have minute stipules. They have flowers which are unisexual in numerous lax and elongated auxiliary spikes. Especially male flowers are minute, terminal or axillary. The male flowers are smaller than the female flowers, and the arrangement is scattered. The fruits are hairy and tiny. It is 1.5-2 mm, 3 lobed, tuberculate and pubescent. The seeds are pale brown, minute in appearance, and ovoid in shape. The bract concealed capsules are small and hispid.[4]

Phytochemistry

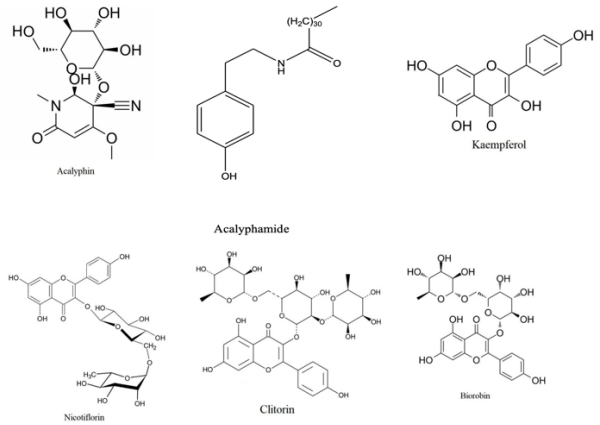
Whole Plant: Tannins, saponins, terpenoids, alkaloids and steroids.

Leaves: Cyanogenic glucoside- acalyphin, acalyphamide, succinimide, aurantiamide and pyranoquinolinone alkaloid - flindersine.
Cyanopyridone derivatives - Epiacalyphin, Noracalyphin, Acalyphin, Epinoracalyphin, Acalyphin amide, Epiacalyphin amide cycloside, ar-Acalyphidone and one corresponding seco compound (seco-Acalyphin).[5,6]

Root: Retusoquinone, ramipril glucuronide, antimycin A, propionylglycine methyl ester, swietenine, quinone, oxprenolol, choline, bumetanide and fenofibrate, piperidine-2, 5-dione, cephalotaxine, 3-deoxy-3,11-epoxy-,(3a,11a) and octadecanoic acid.[7]

Flowers: Mauritianin, clitorin, nicotiflorin and biorobin.[8]

Chemical Structure[9]



Pharmacological Studies

Antibacterial activity: Hexane, chloroform, ethyl acetate and methanol extract of leaves of *Acalypha indica* when used against gram-positive strains, i.e., *Staphylococcus aureus, Staphylococcus epidermidis, Bacillus cereus, Streptococcus faecalis* and gram-negative species i.e., *Klebsiella pneumoniae, Escherichia coli, Proteus vulgaris, Pseudomonas aeruginosa* bacteria strains. Extracts exhibited antibacterial activity against gram-positive organisms at concentrations between 0.156 to 2.5 mg/ml. Only the *Pseudomonas aeruginosa,* gram-negative bacteria, was susceptible to the extracts.[10]

Anti-inflammatory and Analgesic: Methanolic extract of *Acalypha indica* with many interesting phytoconstituents showed analgesic activity on a dose-dependent basis in mice. It inhibited carrageenan-induced inflammation in rats at 125 mg/kg and 250 mg/kg body weight concentrations. Maximum inhibition was at 250 mg/kg body weight, which is comparable to that of the standard drug phenylbutazone at 100 mg/kg.[11]

Antivenom Activity: Ethanol leaf extract at a concentration of 500 and 750 mg/kg of *Acalypha indica* reduced the *Viper russell* venom-induced lethality, haemorrhage, necrotizing and mast cell degranulation in rats on a dose-dependent basis and also exhibited cardiotoxic and neurotoxic effects in isolated frog tissue. The extract also proved activity against venom-induced lipid peroxidation in RBC and decreased GSH and catalase levels of rat kidney tissue.[12]

Antimicrobial and Anti-fungal Activity: Water, ethanol and chloroform extracts of *Acalypha indica* using the disc diffusion method when used against four bacterial and fungal strains, the

antibacterial activity against gram-positive bacteria was more efficient in water and ethanol extracts, whereas anti-fungal activity was more pronounced only in chloroform extract. This was compared with standard antibiotics such as penicillin, enrofloxacin, ampicillin, chloramphenicol, and anti-fungal drugs such as ketoconazole, itraconazole, and fluconazole. The results supported the equal potential of antimicrobial activity of *Acalypha indica* and standard drugs.[13]

Antihyperglycemic Activity: The stem extract of *Acalypha indica* was tested for its postprandial antihyperglycemic potential in maltose, sucrose, and glucose-loaded streptozotocin-induced normal and diabetic rats. Results showed 69.10% and 80.35% blood glucose-lowering effects in maltose and sucrose-loaded diabetic rats compared with the control group. It also recovered the liver damage caused produced by streptozotocin.[14]

Antimicrobial Activity: Root extract of *Acalypha indica* at 600 µg proved to show the highest antioxidant activity of 53.27%. Further exhibited the highest inhibition zone of 14, 12 and 14 mm against various bacterial strains *Escherichia coli, Bacillus subtilis* and *Salmonella typhi*. Hence *Acalypha indica* can be used as a potential antimicrobial agent.[15]

Anti-psoriatic Activity: Aqueous extract of *Acalypha indica* was evaluated for anti-psoriatic activity against A431 and B16-F10 cell lines used as *in-vitro* models. The results proved the efficiency of leaf extract in causing cell death and apoptosis in these cell lines. Further fluorescence studies demonstrated its potent anti-psoriatic activity.[16]

Anti-asthmatic Activity: Ethanolic extract of *Acalypha indica* at a concentration of 100 µg/ml antagonized acetylcholine and histamine-induced contraction of goat tracheal chain proving its anticholinergic and antihistaminic activity.[17]

Antiulcer Activity: Methanolic extract of *Acalypha indica* at concentrations 100 and 200 mg/kg showed a reduction of gastric volume secretion, acidity and ulceration using the standard drug famotidine (20 mg/kg). The results showed methanolic extract *Acalypha indica* produced anti-ulcerogenic effects by the mechanism of possessing antisecretory and cytoprotective mechanism.[18]

Anti-malarial Activity: These solvent extracts of *Acalypha indica* were tested for *in vitro* anti-malarial activity against 3D7 and K1 strains of *Plasmodium falciparum* following the standard laboratory protocol laboratory method. The leaf chloroform and ethyl acetate extract of *A. indica* showed anti-malarial activity at IC_{50} values of 3.34 µg/mL and 3.71 µg/mL against the 3D7 strain. The leaf chloroform and ethyl acetate extracts showed anti-malarial activity at IC_{50} values of 1.47 µg/mL and 2.32 µg/mL against the K1 strain. The presence of potential phytoconstituents such as alkaloids, flavonoids and terpenoids of the plant extracts proved to be excellent for anti-malarial activity.[19]

Anti-fertility Activity: The petroleum ether and ethanol extracts of *Acalypha indica* at 600 mg/kg were more efficient in providing anti-implantation activity at 75% and 62.5% in rats. The chloroform and distilled water extracts showed no anti-fertility activity.[20]

Hepatoprotective Activity: Petroleum ether extract of aerial parts of *Acalypha indica* was reported for hepatoprotective activity using silymarin as a standard drug.

Ethanol extract of the leaves of *Acalypha indica,* when used as treatment against acetaminophen at the rate of 1g/kg induced hepatic damage, exhibits hepatoprotective action through antioxidant activity.[21]

Wound healing Activity: *Acalypha indica* extract at 40 mg/kg was used topically on full-thickness excision wounds in rats once a day, and the tissue was estimated. The ability of *Acalypha indica* to increase collagen synthesis through up-regulation in different phases of wound healing through its antioxidative potential was proved.[22]

Diuretic Activity: Crude drug suspension of *Acalypha Indica* at 450 mg/kg has shown significant diuretic activity. The diuretic activity of crude suspension is more effective than alcoholic extract, which is potential than aqueous extract.[23]

Anthelmintic Activity: Crude alcoholic extract of the root of *Acalypha indica* was used against a test worm, *Pheretima posthuma.* Three concentrations at 10, 25 and 50 mg/ml and their various fractions were tested in the bioassay involving the determination of time paralysis (P) and the time of death (D) of the worms. Albendazole (10 mg/ml) was used as a standard reference, and distilled water as a control. The results proved that crude alcoholic extract has the potential to produce paralysis and also the death of worms, especially at a higher concentration of 50 mg/ml compared to reference albendazole confirming *Acalypha indica* significant anthelmintic activity.[24]

CONCLUSION

Acalypha indica is an important medicinal plant with many bioactive compounds that benefit human health. From the leaves to the plant's roots, many different types of phytochemicals offer a variety of health benefits. Thus, further research should be conducted to understand the therapeutic potential of *Acalypha indica* better so that it can be effectively utilized for treatment purposes, by scientific validation of traditional claims.

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