



## A TYPICAL REVIEW ON ANTIMICROBIAL ACTIVITY OF ACALYPHA INDICA

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### ABSTRACT

**Aim:** The aim of this article to review the antibacterial activity of *acalypha indica*. Medicinal herbs are moving from fringe to mainstream use with a greater number of people seeking remedies and health approaches free from side effects caused by synthetic chemicals. India officially recognizes over 3000 plants for their medicinal value. It is generally estimated that over 6000 plants in India are in use in traditional, folk and herbal medicine. This article also aims to provide a comprehensive review on the pharmacological aspects of *acalypha indica* **Methodology:** The material used to review the antibacterial activity of *acalypha indica* is from 2008 to 2017. The nine years research articles were used to report this review. **Results:** It is obtained from deciduous and mixed-monsoon forests throughout greater parts of India, ascending to 1300 m in outer Himalaya, is widely used in traditional medicinal system of India has been reported to possess hepatoprotective, anti – inflammatory, antitussive, antifungal and also used to check wounds healing and antibacterial.: It is known as a rich source of tannins, flavanoids and glycosides. **Conclusion:** The innumerable medicinal properties and therapeutic uses of *acalypha indica* as well as its Phytochemical investigations and its antibacterial activity prove its importance as a valuable medicinal plant.

**KEYWORDS:** *acalypha indica*, antimicrobial activity.

### INTRODUCTION

*Acalypha indica* (English: Indian acalypha, Indian nettle, three-seeded mercury French: Ricinelle des Indes, oreille de chatte, herbe chatte,<sup>[1]</sup> Muktajhuri in Bengali,<sup>[2]</sup> Tamil: Poonamayakki, Kuppaimeni<sup>[3]</sup> is a species of plant having catkin type of inflorescence. It occurs throughout tropical Africa and South Africa, in India and Sri Lanka, as well as in Yemen and Pakistan. It has possibly been introduced elsewhere as a weed. In West and East Africa the plant is used as a medicinal plant. In West Africa the leaves are cooked and eaten as a vegetable. It is also browsed by cattle.<sup>[4]</sup> This plant is held in high esteem in traditional Tamil Siddha medicine as it is believed to rejuvenate the body.

Many of the plants used today were known to the people of ancient cultures throughout the world and were highly considered their preservative and medicinal powers. Scientific experiments on the antimicrobial properties of plants and their components have been documented in the late 19th century.<sup>[5]</sup>

India has a rich flora that is widely distributed throughout the country. Herbal medicines have been the basis of treatment and cure for various diseases and

physiological conditions in traditional methods practiced such as Ayurveda, Unani and Siddha. Medicinal components from plants play an important role in conventional as well as western medicine. Plant derived drugs have been a part of the evolution of human, healthcare for thousands of years. Plant based drugs were commonly used in India and China.<sup>[6]</sup>

At the same time, indigenous people of the rest of the planet were also utilizing plants for curing diseases. Today, nearly 88% of the global populations turn to plant derived medicines as their first line of defense for maintaining health and combating diseases. One hundred and nineteen secondary plant metabolites derived from plants are used globally as drugs; 15% of all angiosperms have been investigated chemically and of that 74% of pharmacologically active plant derived components were discovered. Currently, people of Asia and India are utilizing plants as part of their routine health management.<sup>[7]</sup>

*Acalypha indica* (family: Euphorbiaceae) is a weed widely distributed throughout the plains of India. It has been reported to be useful in treating pneumonia, asthma, rheumatism and several other ailments.<sup>[8]</sup>

The dried leaves of *Acalypha indica* was made into a poultice to treat bedsores and wounds and the juice of *Acalypha indica* is added to oil or lime and used to treat a variety of skin disorders. The leaves of *Acalypha grandis* have also been reported to possess contraceptive activity.<sup>[9]</sup>

Several chemical and biological investigations have been carried out on this plant. In the present study, an attempt has been made to enrich the knowledge of antibacterial activity of *Acalypha indica* plant extract against Gram-positive and Gram-negative bacteria.

Hexane, chloroform, ethyl acetate and methanol extracts from the leaves of *Acalypha indica* were tested against Gram-positive (*Staphylococcus aureus*, *Staphylococcus epidermidis*, *Bacillus cereus*, *Streptococcus faecalis*) and Gram-negative (*Klebsiella pneumoniae*, *Escherichia coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*) bacteria. All the extracts exhibited antibacterial activity against Gram-positive organisms with minimum inhibitory concentrations (MIC) between 0.156 to 2.5 mg/ml. Among the Gram-negative bacteria, only the *Pseudomonas aeruginosa* was susceptible to the extracts.<sup>[10]</sup>

The antimicrobial activity of water, ethanol and chloroform extracts of *Acalypha indica* was tested against four bacterial and fungal strains using the disc diffusion method. The antibacterial activity against gram positive bacteria was more pronounced ( $p < 0.05$ ) in water and ethanol extracts. Antifungal activity was more significant ( $p < 0.05$ ) only in chloroform extract. This antimicrobial activity was compared to standard antibiotics (penicillin, enrofloxacin, ampicillin and chloramphenicol) and antifungal drugs (ketoconazole, itraconazole and fluconazole). Findings from current study support the use of *Acalypha indica* in traditional medicine for the treatment of various bacterial and fungal infections.<sup>[11]</sup>

The antibacterial activity of *Acalypha indica* was investigated against three strains of human pathogenic bacteria viz., *Bacillus subtilis*, *Staphylococcus aureus* and *Klebsiella pneumoniae* using ethyl acetate, hexane and methanol extracts of leaves, stem and roots of *Acalypha indica*. The ethyl acetate extracts of leaves and roots inhibited the growth of all the three selected bacterial species. The *in vitro* assay may open way for complementary future investigations in identifying potentially useful properties of chemical and pharmacological importance.<sup>[12]</sup>

Dried leaves of *Acalypha indica* was extracted with methanol by cold percolation. From the observed data, crude extraction concentration 500 and 250 µg completely arrest the bacterial growth except *Enterococcus faecalis* and *Shigella boydii*. 125 µg concentration crude extract also completely inhibit the bacterial cell growth in *Escherichia coli*, *Pseudomonas*

*aeruginosa*, and *P. mirabilis* and *Staphylococcus aureus*. In *Vibrio cholera* 62.5 and 32.25 µg concentration of the crude extraction also shows inhibitory activity. The concentration which is completely arrest the bacterial growth, that is determined as minimum bactericidal (500, 250, 125, 62.5, and 31.25 µg concentration) concentration and which concentration is inhibit the bacterial growth comparing with the control culture that is determined as minimum inhibitory concentration (62.5 and 31.25 µg concentrations). From the above investigation the experimental plant may solve the multidrug resistant bacteria problem and further higher studies is need for qualitative study for the present investigation.<sup>[13]</sup>

Selected gram positive bacteria viz *S. aureus*, (ATCC 9144), *Streptococcus* Spp. ATCC 12449, *Bacillus subtilis*, (ATCC 6633) and gram negative bacteria viz. *E.coli* (MTCC 739) *Shigella dysenteriae* locally isolated *Salmonella typhi* (ATCC 12449). The plant world comprises a rich store house of biochemicals that could be tapped for use as an antimicrobial agent. The present paper deals with antimicrobial activity of *Acalypha indica* L. (Euphorbiaceae) against 10749 and *Pseudomonas aeruginosa* (ATCC 25668). The plant contains kaempferol, sitosterol, triacetonamine, amides, quinone, sterols, cyanogenic glycosides, acalyphin, Acalyptus, acalyphamide. The results of the present study showed a good deal of correlation with antimicrobial study and ethnobotanical observations.<sup>[14]</sup>

The objective for this research undertaken was to evaluate *Acalypha indica* extracts for their antimicrobial potential. Fresh plant samples were extracted via maceration in increasing polarity using petroleum ether, chloroform and methanol. Antimicrobial activity of the extracts was assessed using disc diffusion assay and minimum inhibitory concentration. It was observed that the crude methanol leaves, stembark and chloroform stembark extracts exhibit antimicrobial activity towards both *Staphylococcus aureus* bacteria and *Candida albicans* fungi. The inhibition zones recorded in millimeters by the chloroform stembark extracts were  $9.57 \pm 0.51$  (200 mg/mL),  $8.33 \pm 0.58$  (100 mg/mL) and  $7.33 \pm 0.58$  (50 mg/mL) while methanol stembark extract recorded inhibition zones at  $13.67 \pm 0.58$  (200 mg/mL),  $10.00 \pm 1.00$  (100 mg/mL) and  $9.33 \pm 0.58$  (50 mg/mL) against *S. aureus*. Antifungal activity was also detected against *C. albicans* as the chloroform stembark extract produced inhibition zones of  $14.33 \pm 0.58$  (200 mg/mL),  $13.33 \pm 0.58$  (100 mg/mL) and  $12.67 \pm 0.58$  (50 mg/mL) while the methanol stembark extract resulted in inhibition zones of  $15.33 \pm 0.58$  (200 mg/mL),  $14.33 \pm 0.58$  (100 mg/mL) and  $13.0 \pm 0.00$  (50 mg/mL). In the case of crude methanol leaves extract, the extract produced inhibition zones of  $19 \pm 0.58$  (200 mg/mL),  $13 \pm 1.00$  (100 mg/mL) and  $10 \pm 1.00$  (50 mg/mL) against *S. aureus* while against *C. albicans*, the extract recorded inhibition zones of  $15 \pm 0.58$  (200 mg/mL),  $14 \pm 0.00$  (100 mg/mL) and  $13 \pm 0.00$  (50 mg/mL). The chloroform stembark

crude extract developed a medium MIC value of 0.938 mg/mL while both methanol crude extracts produced a strong MIC value of 0.469 mg/mL during the minimum inhibition concentration screening against *Candida albicans*.<sup>[15]</sup>

The present study is about the evaluation of antibacterial and antifungal activities of crude extracts of leaves of *Acalypha indica* using different solvents like petroleum ether, chloroform, ethyl acetate, acetone and methanol. The effect of different extracts were tested on Gram positive bacteria like *Staphylococcus aureus*, *Streptococcus pyogenes* and Gram negative bacteria like *Escherichia coli*, *Pseudomonas aeruginosa*, *Proteus vulgaris*, *Shigella flexneri* and *Proteus mirabilis* and on the fungal species *Candida albicans*, *Candida tropicalis* and *Aspergillus flavus* by in vitro disc diffusion method.<sup>[16]</sup>

*Acalypha indica* is herb found in tropical countries. This is used traditionally for treating various diseases for centuries, including anti-bacterial and anti-fungal activities. Thus, the objective of this present investigation was to perform qualitative analysis of phytochemical compounds and also evaluate *in vitro* anti-bacterial activity of *Acalypha indica*. Crude ethyl acetate, petroleum ether and Toleune extract of leaves from *Acalypha indica* were tested for anti-bacterial activity against four bacterial species – *Klebsiella pneumoniae*, *Salmonella typhi*, *Bacillus subtilis* and *Pseudomonas putida*. It is inferred that ethyl acetate extract exhibited strong antibacterial activity with a maximum activity recorded against *Klebsiella pneumoniae* ( $22.67 \pm 0.33$  mm). The qualitative phytochemical screening indicated the presence of alkaloids, phenols saponins, steroids, flavonoids and catechol.<sup>[17]</sup>

Nosocomial infections occur worldwide, both in the developed and developing world. They are a significant burden to patients and public health. They are a major cause of death and increased morbidity in hospitalized patients. They may cause increased functional disability and emotional stress and may lead to conditions that reduce quality of life. In this present study, the herbal plant *Acalypha indica* was tested for its antibacterial activity against Nosocomial infection causing bacteria. The *Acalypha indica* was shade dried and the antimicrobial principles were extracted with Methanol, Acetone, Chloroform, Petroleum Ether and Hexane. The antibacterial activity of *Acalypha indica* was determined by Agar Well Diffusion Method. It was found that 50mg/ml of methanolic extract of the plant able to inhibit the growth of nosocomial infection causing bacteria when compared to other solvent extracts. From this it was concluded that the solvent methanol able to leach out antimicrobial principle very effectively from the plant than the other solvents. The phytochemicals present in the *Acalypha indica* was tested and it conferred that

the possible antibacterial principle resided in tannins and alkaloids.<sup>[18]</sup>

For centuries, medicinal plants are being used as remedy for various ailments throughout the globe. The study was conducted emphasizing on the antibacterial and antioxidant activities of several *Acalypha indica* extracts. The plant was divided to leaves and stem, whole plant and roots and extracted with hexane, methanol and ethanol by successive method. Antioxidant activity was measured by 2,2-diphenyl-1-picrylhydrazyl (DPPH) Radical Scavenging assay and found to be highest in the ethanolic root extract with IC<sub>50</sub> of 206 µg/ml. The antibacterial activity screening of different extracts was conducted by using disc diffusion, minimum inhibition concentration (MIC) and minimum bactericidal concentration (MBC) against *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Enterococcus faecalis*. Hexane extracts from leaves and stem, whole plant and roots showed promising results against *Enterococcus faecalis* with high inhibition zone at 10 to 12 mm as compared to standard antibiotics, 6 to 10 mm. All extracts showed antibacterial activity with minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) values in the range from 60 to 15 mg/ml. This study concludes that *A. indica* explicit antioxidant and antibacterial activities may be potential for pharmaceuticals, cosmeceuticals, nutraceuticals, medical and food industry.<sup>[19]</sup>

The antimicrobial activity of water, ethanol and chloroform extracts of *Acalypha indica* was tested against four bacterial and fungal strains using the disc diffusion method. The antibacterial activity against gram positive bacteria was more pronounced ( $p < 0.05$ ) in water and ethanol extracts. Antifungal activity was more significant ( $p < 0.05$ ) only in chloroform extract. This antimicrobial activity was compared to standard antibiotics (penicillin, enrofloxacin, ampicillin and chloramphenicol) and antifungal drugs (ketoconazole, itraconazole and fluconazole). Findings from current study support the use of *Acalypha indica* in traditional medicine for the treatment of various bacterial and fungal infections.<sup>[20]</sup>

The extracts of *Acalypha indica* were tested against pathogenic bacteria's by Agar well diffusion method. The ethanol extract of *Acalypha indica* showed maximum inhibition against *Bacillus cereus*, *Bacillus subtilis*, *Escherichia coli*, *Salmonella typhi*, *Vibrio cholera* and *Pseudomonas aeruginosa* of ethanol extract showed resistant against *Pseudomonas aeruginosa*, *Shigella flexneri*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Vibrio cholerae* and *Bacillus cereus*. The ethyl acetate extract of *Acalypha indica* showed maximum inhibition against *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Shigella flexneri* ethyl acetate was resistant to *Vibrio cholerae* and *Bacillus cereus*. *Pseudomonas aeruginosa* was resistant to ethyl acetate extract of *Acalypha indica*. Antimicrobial activity of

*Acalypha indica* plant leaves is due to the presence of phytochemical compounds like tannins and alkaloids.<sup>[21]</sup>

The herb *Acalypha indica* which belongs to Euphorbiaceae family has multiple medicinal properties which include anti-oxidant, anti-bacterial, anti-fungal, anti-inflammatory, antiulcer, anti-helminthic, anticancerous, anti-venom, and neuro-protective activity. The present study was designed to evaluate the phytochemical, antimicrobial and anti-oxidant activity of *Acalypha indica* leaves extracts in different solvent extractions like methanol, hexane, ethyl acetate and petroleum ether. Fresh leaves of the plant were collected and shade dried. Dried leaves were milled to obtain powder. Powder was subjected to soxhlet extraction using solvents and extracts were successively obtained. Phytochemical analysis was conducted following standard methods. Phytochemical analysis showed the presence of Alkaloids, Phenols, Saponins, Flavanoids and Amino acids. Leaf extract of methanol have shown the highest anti-oxidation capacity than hexane, ethyl acetate and petroleum ether. Anti-microbial activity has been performed on microbes like *Bacillus sps*, *E.coli*, *Psuedomonas sps* and *Streptococcus sps*. A highest value of zone of inhibition was found in methanol extract against *E.coli*. These results provide evidence that *Acalypha indica* leaf extract possesses vital phytochemicals, antimicrobial and antioxidant properties. Hence this plant can be studied further for drug analysis for finding potent medicines for diseases.<sup>[22]</sup>

Number of resistant antibiotics is increasing and antibacterial activity testing is one of the steps to find treatment of diseases. *Acalypha indica* is well known medicinal plant and it a wild plant. It was used as infection treatment for generation to treat several diseases such as asthma, and pneumonia. A study on the antibacterial activity of this plant extract with different solvent used to support the therapeutic claims. The extract was prepared through maceration of dried powdered leaves and roots using methanol and water. It was tested with three different concentrations which were 70, 90 and 110 mg/ml. The streptomycin 10 $\mu$ g was served as positive control while distilled water was used as negative control. Both extracted was tested on two gram positive bacteria (*S. aureus* and *B. subtilis*) and two gram negative bacteria (*E.coli* and *P. aeruginosa*) by using disc diffusion method. The results show that less antibacterial activity on both part of plant extract and extract with two different solvent due to insufficient or too low concentration. The mutant *E.coli* gene is one of other factor that affects the antibacterial activity result.<sup>[23]</sup>

*Acalypha indica* (Indian Acalypha), commonly known as Mukhtajhuri in West Bengal is an important medicinal plant of India. The leaves are known to possess antimicrobial and antifungal properties. Leaf decoction is said to have anti-inflammatory properties. The present study shows the presence of antioxidant and antibacterial

properties of *Acalypha indica* leaf extract and leaf-derived callus extract. Antioxidant activity was studied through DPPH assay. Whereas, in vitro antibacterial study of the extracts were carried out by adopting agar well diffusion technique using the pathogens *Escherichia coli* (*E. coli*), *Klebsiella sp*, *Salmonella sp*, *Bacillus sp*. After 24 hours of incubation maximum zone of inhibition was found against *Bacillus sp*. for leaf extract and *Salmonella sp*. for callus extract. These activities may be due to presence of flavonoids, phenolic compounds and other secondary metabolites present in these extracts.<sup>[24]</sup>

Psoriasis is a chronic inflammatory skin disorder characterized by rapid proliferation of keratinocytes and incomplete keratinization. Discovery of safer and more effective anti-psoriatic drugs remains an area of active research at the present time. A431 and B16-F10 cell lines were used as *in vitro* models. In the present study, we aimed at assessing the Anti-psoriatic activity of aqueous extract of *Acalypha indica*. We analyzed the efficiency of *A. indica* leaf extract in inducing cell death and apoptosis in these cell lines. The cell death (Propidium iodide) and apoptosis (Annexin V) was assessed by fluorescence studies and we observed 80% of cell death and 75% of apoptosis in both cell lines. Therefore, this *in vitro* study suggested that the leaf extract is capable of serving as anti-psoriasis agent or compound.<sup>[25]</sup>

The screening and study of five different plant specimens belonging to different families for phytochemical constituents was performed using generally accepted laboratory technique for qualitative determinations. The constituents screened were saponins, combined anthraquinones, terpenoids, flavonoids, carotenoids, steroids, xantho proteins, couramins, alkaloids, quinones, vitamin C. The distribution of these constituents in the plant specimens were assessed and compared. The medicinal plant studied were *Acalypha indica*, *Camellia sinensis*, *Plectranthus amboinicus*, *Curcuma longa*, *Rauvolfia tetraphylla*. All the plant specimens were found to contain terpenoids, xantho proteins, couramins and vitamin C. They also contain Saponins (except *Curcuma longa*), Combined anthroquinones (except *Acalypha indica*, *Camellia sinensis*, *Curcuma longa*) flavonoids (except *Acalypha indica*, *Camellia sinensis*), Carotenoids (except *Acalypha indica*, *Curcuma longa*), and steroids (except *Plectranthus amboinicus*, *Rauvolfia tetraphylla*) Quinones were found in one out of the five specimens. Some of the medicinal plant seemed to have potential as source of useful drugs. Though the one percent extracts of all the plants showed some degree of antimicrobial activity, it was significant in *Acalypha indica*, *Camellia sinensis*, *Plectranthus amboinicus*, *Curcuma longa*, and *Rauvolfia tetraphylla*. The extract of *Camellia sinensis* and *Acalypha indica* was most effective against *Enterobacter faecalis* (ZI = 3 cm and ZI = 1.7cm) and *Camellia sinensis* and *Acalypha indica* was most effective against *Staphylococcus aureus* (ZI = 2.1 cm).<sup>[26]</sup>

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