



## Ethno-Pharmacological Importance and Valuable Phytochemicals of *Acalypha indica* (L.) A Review

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### ABSTRACT

Enormous research works have recently been carried out on phytochemical analyses of the medicinally important plant, *Acalypha indica* (L.), specially its antimicrobial activity. Moreover, the ethno-pharmacological importance has been described in several Siddha, Ayurvedic literatures. Recent discovery of several important drugs from the plant, including few novel compounds, made it research-worthy. This also justifies the importance of its conservation and exhaustive phytochemical exploration. The present review sheds light on current research trends of *Acalypha indica* in view of its diverse ethnomedicinal uses and as a potential source of valuable drugs and unique phytochemicals.

**Keywords:** *Acalypha indica*, Phytochemicals, Pharmacological Use, Antimicrobial activity, GC-MS Analysis

### INTRODUCTION

Plant based drugs have been used worldwide in traditional medicines for treatment of various diseases. India is the largest producer of medicinal herbs and appropriately called the botanical garden of the world (Ahmedulla et al., 1999). The increase of presence of multiple drug resistance has slowed down the development of new synthetic antimicrobial drugs and necessitated the search for new antimicrobial drug from alternative sources. One way to prevent antibiotic resistance is by using new compounds which are not based on the existing synthetic antibiotic agents (Shah, 2005). Phytochemicals from medicinal plants showing promising effect against bacterial and fungal resistance diseases (Omar et al., 2002). *Acalypha indica* (L.) is an important medicinal plant of the family Euphorbiaceae. It is a small erect herb up to 60 cm tall or little more, with a few ascending branches. These angled and pubescent leaves broadly ovate, sub deltoid, rather coarsely toothed, on petioles as long as or longer than 3-5 cm long blades. Stipules minute; flower sessile on erect axillary spikes longer than leaves; male flowers minute, crowded distally, stamens 8, female flowers scattered along the inflorescence axis each subtended by a conspicuous semicupular, foliaceous toothed green bract nearly 7 mm long; capsule hispid, 1mm, broad, 3 locular (Stone, 2007). This medicinal plant is much enriched with different phytochemicals which have

important medicinal values on humans and other animals. *Acalypha indica* is widely used in Siddha and Ayurvedic medicine. This plant has antibacterial and antifungal activity (Jebekumar et al., 2005). Several reports of Ayurvedic, Siddha and folk medicinal uses on *Acalypha indica* make the plant worthy on medicinal point of view.

It is a common weed in all over the world. It occurs in Nigeria and from Sudan East to Somalia and South through Dr. Congo and East Africa including South Africa. It is wide spread in Indian Ocean islands and occurs further more in India. South East Asia and Oceania. It was introduced in the warmer part of the new World.

*Acalypha indica* comprises about 460 species and warm temperate regions, excluding Europe. This plant is well known for its leaf mosaicism. The plant is sometimes severely affected by *Pseudomonas spora acalypha*. It is also a host of several viruses e. g. Pumpkin yellow vein mosaic virus, Okra yellow virus 10, leaf curl virus and Nicotiana virus 10. In India *Acalypha indica* is a host of spiraling white fly (*Aleudiscus disperses*) (Schmelzer, 2012). This medicinal plant is much enriched with different phytochemicals, which have important medicinal values on human and other animals. This plant has antibacterial and antifungal activity. This review presents an updated review on current research status of *Acalypha indica* (L.) highlighting its diverse ethnomedicinal applications. The paper also examines the prospect of the plant as a potent source of valuable drugs and novel phytochemicals.

### PHYTOCHEMICALS PRESENT IN *Acalypha indica* (L.)

The qualitative analyses of the extracts from the root and leaf of *Acalypha indica* exhibited the presence of phytochemical constituents like alkaloids, flavonoids,

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phenolic compound, saponins and sterol (Chitravadivu et al., 2009).

*Acalypha indica* leaf and flower showed the antioxidant activity due to presence of flavonoids, Kaempferol, glycosides, mauritianin, clitoria, nictiflorin (Dinesh Kumar et al., 2012).

The whole plant contains various saponins and alkaloids. Acalyphamide a new amide is isolated from root. Acalyphin, a cyanogenic glycoside is isolated from leaves and twigs (Anonymous In, CSIR, 1985; Govindachar, 1981; Mahato et al., 1982; Mahato et al., 1983).

GC-MS analysis of MeOH root extract of *Acalypha indica* reported some novel medicinal chemicals, like imipramine, Proadifen, Phenyttain, Dimethylnitromethane, Methoxyphenamine (Sinha et al., 2012).

### MEDICINAL USES IN SIDDHA

The leaf juice or decoction of leaf is prepared and given in a dose of 1-2 table spoon in case of small child emesis or purgative and hence pels the intestinal worms and mucous from intestine.

The juice of leaves is boiled along with gingelly is applied externally over painful areas of the body.

The leaves are ground with salt and externally applied on skin infection like scabies.

The leaves are ground with manjal and applied externally over ulcers and poisonous bite.

The paste of leaves along with lime is externally used in painful arthritis.

The leaf juice is externally applied over headache.

The dried leaf powder is bandaged over bed sore areas and hence produce and anthelmintic action.

The decoction of roots is also used to induce as purgative.

The leaf juice along with neem oil is applied over uvula of small children. This will induce emesis and elim.

In east Africa the leaf sap is used as eye drop to treat eye infection.

Leaf powder is applied to maggot infected wounds to treat it.

In Seychelles, a root decoction is also taken to treat intestinal worms and stomachache.

A leaf infusion is also taken as purgative

In India it is used as expectorant to treat asthma and pneumonia.

Decoction of leaves is used for dysentery.

Poultice of bruised leaves used for syphilitic ulcers.

Root, bruised in water, used as cathartic.

The leaves in decoction and in powder form are used as laxative.

Paste of leaves is applied in burning lesions. (Joshep, 2009).

### *Acalypha Indica* IN AYURVEDA

There are several uses on *Acalypha indica* in Ayurveda. These are as follows

Leaves possesses laxative properties, are used as a substitute for senega in the form of powder or decoction.

Mixed with garlic, they are used as Anathematic in worms. They are also used in Scabies and their juice is mixed with oil forms an application in rheumatic arthritis.

Expressed juice of leaves is a safe, certain and speedy emetic for the children in teaspoonful doses. In cases of croup in smaller doses it is used as expectorant and is useful in chronic bronchitis, asthma, and consumption. The decoction is employed in ear ache as instillation and as fomentation round the aching ear. And a cataplasm of the bruised leaf is applied to syphilitic ulcers, maggot eaten soars and also to relief the snake bite.

Powder of dry leaves is used in bed soar.

In case of obstinate constipation of children the leaves ground into a paste and made into a ball and introduced into rectum, relax the sphincter and produces free motion.

An infusion of root or the root bruised in water acts as a cathartic (Walter, 2012).

### PHARMACOLOGICAL STUDIES

#### Post coital Infertility activity

Four successive solvent extracts of the whole plant were tested for post coital antifertility activity in female albino rats. Of these the petroleum ether extract and ethanol extract were found to be most effective in causing significant anti-implantation activity. The antifertility was reversible on withdrawal of the treatment of the extract. Both the extract at 600mg/kg body weight showed estrogenic activity. Histological studies of the uterus were carried out to confirm this estrogenic activity (Shivayogi et al., 1999).

#### Anti Venom properties

An ethanolic leaf extract showed significant inhibition to *Viper russelli* venom, induced lethality, hemorrhage, necrotizing and mast cell degranulation in rats and the cardiotoxic and neurotoxic effects in isolated frog tissue. Administration of an ethanolic extract also significantly inhibit venom induced lipid per oxidation and catalase levels of the rat kidney tissue (Shirwarikar et al., 2004).

### Haemolysis

Four patients who developed acute intravascular haemolysis after ingestion of a broth containing *Acalypha indica* (Sinhala: Kuppymeniya) are reported. All four patients were found to have glucose 6-phosphate dehydrogenase deficiency. It is common belief that ayurvedic medicines were free from side effects. Our report confirms again the fallacy of the belief (Lamabadusriya et al., 1994).

### Antiulcer activity

The result of the study was established a cytoprotective action of stomach tissue cells treatment upon MEAI (Methanolic Extract of *Acalypha indica*) on pylorus ligation and swim stress induced ulceration in the Wistar rats by conducting various parameters with histopathological sectioning. The plant MEAI was used two different doses (100 and 200mg/kg) and protected the stomach from the cytodestructive damage in the gastric mucosa of rats and cytoprotection was given by the herbal drug has been considered to be due to generation of the gastric mucosa by antiulcer drugs when used in their non-anti-secretory drugs. The cytoprotection was significantly observed on MEAI by dose dependently reduced the extent of gastric ulceration in pylorus ligated rats and swim stress induced ulcer without affecting the gastric secretion or pepsin activity (Kalimuthu et al., 2010).

### Antimalarial activity

The leaf extract of *Acalypha indica* with different solvents viz, benzene, chloroform, ethyl acetate and methanol were tested for larvicidal, ovicidal activity and oviposition attractancy against *Anopheles stephensi*. The larval mortality was observed after 24 h exposure. The LC (50) values are 19.25, 27.76, 23.26 and 15.03 ppm, respectively. Mean percent hatchability of the ovicidal activity was observed 120 h after treatment. The percent hatchability was inversely proportional to the concentration of extract and directly proportional to the eggs. The highest effective attractancy of 90.09%, 94.20%, 85.43% and 95.75% were observed at 100 ppm concentration viz, benzene, chloroform, ethyl acetate and methanol, respectively. The lowest effective attractancy of 47.17%, 61.94%, 49.28% and 68.12% were observed at 25 ppm concentration viz, benzene, chloroform, ethyl acetate and methanol, respectively. The results that the leaf extract of *A. indica* is promising as larvicidal and ovicidal activity and oviposition attractancy against malaria vector *A. stephensi* (Govindarajan et al., 2011).

### Analgesic and Anti-inflammatory Activity

The methanolic leaf extract of *A. indica* showed statistically significant ( $P > 0.001$ ) analgesic activity in mice in a dose dependent manner. A sustained and significant inhibition of carrageenan-induced inflammation of rat paw was observed with 125mg/kg and 250mg/kg body weight. The methanolic extract of *A. indica* L. also

demonstrated anti-inflammatory effect in a dose dependent manner. Maximum inhibition by the extract was observed at 250mg/kg body weight after three hours of ingestion, which was comparable to that of the standard drug phenylbutazone at a dose of 100 mg/kg body weight. The obtained results provide a support for the use of plant in traditional medicine (Rahaman et al., 2010).

### Alfa-amylase inhibitory activity

Different extracts of (hexane, chloroform and ethanol) of *Acalypha indica* were prepared. Extracts were prepared for porcine pancreatic amylase (PPA) inhibitory assay. Hexane extract of *A. indica* failed to inhibit the alfa-amylase activity, whereas the chloroform and ethanol extract showed 75.32% and 84.51% dose dependent amylase inhibition against pancreatic amylase *in vitro* respectively. Further, it was suggested that *Acalypha indica* may have a beneficial effect in the management of diabetes (Nandakumar et al., 2009).

### Anti-tuberculosis activity

Emergence of multidrug resistant (MDR) and extensively drug resistance (XDR) strains of *Mycobacterium tuberculosis* has further complicated the problem of tuberculosis control. Medicinal plants offer a hope for developing alternative medicines for the treatment of TB.

Aqueous extract of leaves of *A. indica* were tested *in vitro* for their activity against the MDR isolates (DKU-156 and JAL-1236), reference susceptible strain *M. tuberculosis* H37Rv as well as rapid grower *Mycobacterium* pathogens *M. formicum* (TMC-1529) using Lewenstein-Jensen medium and colorimetric BacT/ALERT 3D system. Activity in L-J medium was calculated by percentage inhibition which was calculated by mean reduction in number of colonies on extract containing as compared to extract free controls. Extract of the plant *A. indica* exhibited 95% inhibition of MDR isolate DKU-156 and 68% of the MDR isolate JAL-1236 in L-J medium (Gupta et al., 2010).

### Neuro-protection and neuro-therapy Effects of *Acalypha indica* (L.)

The studies of neuroprotection and neuro therapy effects of *Acalypha indica* water extract on Gastrocnemius frog have already done in the University of Indonesia. The experimental studies were done on 2 groups of frog for neuroprotection and neurotherapy effects. Each group of frog was divided into 7 subgroups of application, 4 samples each. There were 5 sub groups of doses: 5, 10, 15, 20, 25 mg and 2 subgroups as control. Pancuronium bromide 0.2%, 4 mg was used for a positive control as muscle relaxant. Neuro-protection study was done as follow: ringer-extracts-pancuronium bromide and neuro-therapy study was ringer-pancuronium bromide-extracts, respectively. The parameter measured in this studies were the electrical activities such as amount of duration (second) of repo-

larization, depolarization, resting potentials and the height of the spike after electrical stimulation at 5 mV. Neuroprotection effects of extract was determined by the ability of the muscles to show the electrical response after incubating with pancuronium bromide for 10 minutes and after incubating with extract for 10 minutes for neuro therapy effect. In the dose of 15mg and 20mg/ml of *Acalypha indica* Linn. , extract showed better activities than the dose of 25 mg of extract, both as neuro-protection and neuro- therapy effects, but statistically it has no significant difference. This study should be followed by an *in vivo* experiment on frog and it would be done in pharmacokinetic and pharmacodynamic studies on other animals (Purwaningsih et al., 2008).

#### Wound healing properties of *Acalypha indica* (L. )

Herbal medicines have been the basis of treatment and cure for various diseases. Physiological condition in traditional methods, practice, such as Ayurveda, Unani and Siddha.

The dried leaves of *Acalypha indica* is added to oil or lime and used to treat a variety of skin disorders. The dried leaves of *Acalypha indica* are made into a poultice to treat bed soar.

The ethanolic extracts were evaluated for their wound healing activity in rats. The water extracts of *A. indica* showed the maximum zone of inhibition for *Streptococcus aureus* and *Pseudomonas aureginosa*. This screening of antibacterial activity from coastal population of medicinal plants has been proved highly effective to control the wound infective bacteria (Vinoth Raja et al., 2009).

#### Diuretic Activity of *Acalypha indica* (L. )

Here adult albino mice were used for this kind of experiment. The animals fasted and deprived of water for 18 hours prior to experiments were divided in five groups of six mice each. The methanolic extract of *Acalypha indica* showed significant diuretic effect in albino mice. Maximum diuretic action was observed at the dose of 400mg/kg body weight after five hours of ingestion which was comparable to that of the standard drug frusemide at the dose of 20mg/kg body weight. The firstgroup of mice, as control, second group received irea in saline as a reference, third group was treated with frusemide, fourth and fifth group were treated with test extract at doses of 200 and 400 mg/kg of the body weight. After 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> hours the cumulative amount of urine excreted, were analyzed by flame photometric method. Treatment with aqueous extract of *A. indica* at the dose of 200 and 400 mg/kg of body weight, caused an increase in urine volume with a significant increase in Na<sup>+</sup> and Cl<sup>-</sup> excretion, accompanied by a significant excretion of K<sup>+</sup>. From this experiment it has been shown that the methanolic extract of aerial parts of *Acalypha indica* pos-

sess diuretic activity and this it is traditional use as a diuretic, justified (Das et al., 2005).

#### *In vitro* anthelmintic activity of roots of *Acalypha indica* Linn.

Anthelmintic potential of alcoholic extract of root of *Acalypha indica* was evaluated using *Pheretima posthuma* as test worm. Three concentrations (10, 25 and 50 mg/ml) of alcoholic extract and its various fractions were tested in the bioassay, which involved determination of time paralysis (P) and the time of death (D) of the worms. Albendazole (10 mg/ml) was included as standard reference and distilled water as control. The results of study indicated that crude alcoholic extract significantly demonstrated paralysis and also caused death of worms especially at higher concentration of (50 mg/ml) used as compared reference Albendazole. *Acalypha indica* showed the best anthelmintic activity. The use of the roots anthelmintic has been confirmed and further studies are suggested to isolate the active principles responsible for the activity (Chengaiyah et al., 2009).

#### Antidiabetic activity of *Acalypha indica* (L. )

The investigation was carried out to study the antidiabetic effects of the methanol and acetone (70:30) extract of *Acalypha indica* Linn. In normal and Alloxan induced diabetic model. The antidiabetic effects of the methanol and acetone extract of *Acalypha indica* Linn. was evaluated in normal and Alloxan induced diabetic rats. Decreased blood glucose level of the test animals shows that the extract exhibit significant antidiabetic activity when compared to diabetic control group. The results also indicated the dose dependent effect. The antidiabetic activity produced by the extract may be due to increased uptake of glucose at the tissue level or by an increase in pancreatic beta cell function or due to inhibition of intestinal absorption of glucose. The study supports the use of this herbal drug as antidiabetic. (Masih et al., 2011).

#### ANTIMICRIBIAL ACTIVITY OF *Acalypha indica* (L. )

##### Antibacterial activity of Extract of *Acalypha indica* (L. )

The leaves of *A. indica* were air dried and powdered leaves (500g) were extracted with petroleum ether (40-60) using a Soxhlet extractor. The defatted mare was successively extracted with chloroform and methanol. The methanolic extract was further fractioned with acetone. These extracts were tested for *in vitro* anti-microbial activity against *E. coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Salmonella typhosa*, *Bacillus subtilis* and fungi that included *Candida albicans*. Sterile nutrient broth double strength (peptone broth and Sabouraud's Dextrose Agar media) was used for determination of MIC of the extract. The chloroform extract as well as methanolic extract fractions exhibited prominent antimicrobial activity against all the microorganisms. All the microorganisms were most sensitive to the chloroform extract.

The acetone soluble and acetone insoluble fractions of methanolic extract exhibited prominent antimicrobial activity. The MIC of chloroform extract against all the microorganisms was found to be 0.4 mg/ml. The acetone soluble fraction of the methanolic extract exhibited MIC of 0.05 mg/ml against *S. typhosa* and *C. albicans*. The acetone insoluble fraction of methanolic extract exhibited MIC of 0.004 mg/ml against *S. aureus* (Gopalkrishnan et al., 2000).

#### **In vitro Anti-bacterial and anti fungal Properties of *Acalypha indica* (L.)**

*A. indica* (L) is used traditionally for the treatment of various diseases for centuries, antibacterial and antifungal activities. Thus the objective of the investigation is to evaluate *in vitro* antibacterial and antifungal properties of *Acalypha indica*. Crude ethanol and water extract of leaves, stem, seed and root from *A. indica* were tested for antibacterial activity *in vitro* against two bacterial strains e. g. *E. coli* (Gram negative) and *Staphylococcus aureus* (Gram positive) and for antifungal activity against three fungi *Aspergillus fumigatus*, *Microsporous canis* and *Candida albicans*. Sterile disc (6mm) impregnated with both extracts were used for the *in vitro* sensitivity testing. Six different concentrations were used (6, 10, 15, 25, 30 µg/µl). *Microsporous canis* showed dose dependent sensitivity towards aqueous leaves and root extracts. *A. fumigatus* and *Candida albicans* were resistance towards both ethanol and water extracts. The inhibitory zone of both water leaves and roots extracts for *Microsporum canis* was 2.4 cm. Results were then compared to standard antifungal drug, Fluconazole, Ketozazole or Tioconazole (0 and 18mm) respectively at 30 µg/µl concentration.

Negative results were obtained for antibacterial activity on *E. coli* and *S. aureus*. This suggested that *A. indica* extract does not possess antibacterial properties up to a concentration of 30 µg/µl.

Based on the current findings, it can be concluded that this plant has potential antifungal properties thus providing a scientific basis for utilization of the plant in herbal medicine for treatment of fungal infection. However further studies are needed to confirm the antibacterial activity at higher extract concentration (Azmahani et al., 2002).

#### **Isolation, identification and study of antimicrobial property of a bioactive compound in an Indian medicinal plant *Acalypha indica* (L.)**

Fresh dried and powdered samples of the leaf, stem and root of *Acalypha indica* were subjected to fractional distillation in a soxhlet apparatus using solvents such as hexane, chloroform acetone and methanol. The plant extracts and a synthetic antifungal compound, clotrimazole (authentic standard) were subjected to TLC and HPLC analyses. Clotrimazole is now utilized extensively as a front line topical antifungal

agent for prevention of mucosal candidiasis in immunocompromised patients.

The  $R_f$  value of clotrimazole was 0.371. The plant's leaf, root and stem extracts also give distinct spots respectively at  $R_f$  value of  $0.371 \pm 0.0009$ . In HPLC and TLC separated active compound clotrimazole resolved at  $1.90 \pm 0.2$  min. The amount of active compound present in root, leaf, stem, extract was 538, 415 and 171 µg/g respectively. From the result of the study, it is concluded that the active compound isolated from *A. indica* is more potent in controlling *Candida albicans*, *A. niger* and *E. coli*. The active compound present in the plant had more than 100% activity when compared to standard clotrimazole (Jebakumar et al., 2005).

#### **Antibacterial Activity of *Acalypha indica* (L.)**

To show the antibacterial activity of *A. indica* (L) the shade dried coarsely powdered leaves were subjected to Soxhlet extraction using hexane, chloroform, ethyl acetate and methanol. These extracts were tested against Gram positive bacteria- *Staphylococcus aureus*, *Staphylococcus epidermis*, *Bacillus cereus* *Streptococcus faecalis* and gram negative bacteria – *Klebsiella pneumoniae*, *E. coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*

Hexane, Chloroform, Ethyl acetate and methanol extract of *A. indica* leaves showed significant zone of inhibition against the entire above mentioned gram positive bacteria and one gram negative bacteria were not inhibited.

From this above experiment, the data showed that in general the plant antibacterial extract substances appear to be more inhibitory to Gram positive organisms than to the Gram negative types.

These kind of negative results in case of gram negative bacteria were not expected, since this class of bacteria is usually more resistance than gram positive bacteria, because unlike Gram positive bacteria, the lipopolysaccharide layer along with proteins and phospholipids are the major components in the outer surface of gram negative bacteria.

The antibacterial activity of the active compound isolated from ethyl acetate extract of the leaf, stem and root of *A. indica* was performed using a modification of agar disc diffusion method.

The more potent growth inhibitory nature of ethyl acetate extraction of leaf was supposed to the fact that ethyl acetate an organic solvent better liberate the active component required for antimicrobial activity.

The ethyl acetate extract of leaf was further subjected to TLC. The bands appeared on the developed chromatogram were individually eluted with ethyl acetate and screened for antibacterial activity. Of the four bands the yellowish organic coloured band showed antibacterial activity, which can be purified.

The result of this work indicates that the difference in the zone of inhibition may be directly related to the susceptibility of each test organism to the leaf extract.

The factors responsible for this high susceptibility of the bacteria to the extracts are not exactly known but may be attributed to the presence of secondary plant metabolite which is soluble in ethyl acetate.

It is noteworthy that the antimicrobial activities of these plant extracts were dependent on the concentration of the extract (Govindarajan et al., 2008).

#### The antibacterial activity of *Acalypha indica* L.

*In vitro* antimicrobial screening methods could provide the needed preliminary observation necessary to select among crude extracts those with potentially useful properties for further chemical and pharmacological investigation. Earlier it was reported that the endophytic fungi isolated from the leaves of *A. indica* elicited promising antibacterial activity against the three human pathogenic bacteria, *Bacillus subtilis*, *Staphylococcus aureus* and *Klebsiella pneumoniae*. Further studies are needed for the clarification of the precise functioning of the active ingredient(s) of the plant extracts in purified form for *in vitro* and *in vivo* antibacterial activities (Gangadevi et al., 2008).

#### Synthesis of silver nanoparticles using *Acalypha indica* leaf extracts and its antibacterial activity against water borne pathogens

Biosynthesis of silver nanoparticles and its activity on water borne bacterial pathogens were investigated. Silver nanoparticles were rapidly synthesized using leaf extract of *Acalypha indica* and the formation of nanoparticles was observed within 30 min. The results recorded from UV-vis spectrum, scanning electron microscopy (SEM), X-ray diffraction (XRD) and energy dispersive spectroscopy (EDS) support the biosynthesis and characterization of silver nanoparticles. From high-resolution transmission electron microscopy (HRTEM) analysis, the size of the silver nanoparticles was measured 20–30 nm. Further, the antibacterial activity of synthesized silver nanoparticles showed effective inhibitory activity against water borne pathogens viz. , *Escherichia coli* and *Vibrio cholerae*. Silver nanoparticles 10 µg/ml was recorded as the minimal inhibitory concentration (MIC) against *E. coli* and *V. cholerae*. Alteration in membrane permeability and respiration of the silver nanoparticle treated bacterial cells were evident from the activity of silver nanoparticles (Krishnaraj et al., 2011).

#### *Acalypha indica* root extract on Impetigo treatment

Still now the plant *A. indica* has no report on the treatment on impetigo. The disease impetigo is primarily caused by *Staphylococcus aureus*, and sometimes by *Streptococcus pyogenes*. Finding on *A. indica* root mustard oil extract shows a distinct recovery activity of impetigo, especially to the children, which cause burn-

ing “Narenga” wound. The roots of *A. indica* are cut into small pieces and they are then dried in sun light. After that the cut pieces of the root are dipped into metal or soil mustered oil lamp. When the lamp is lighted, the mustard oil with the small cut pieces of root leaches some chemical substances which is warmed up slightly after the burning up of the lamp for 10 to 15 mins. After that, this slightly loked mustard oil is then applied to the bacterial infected part of the body for 2 to 3 times in a day. With this kind of application of mustard oil to these infected parts within 4 to 5 days the burning lesions of the wound caused by *Staphylococcus aureus* or *Streptococcus pyogenes* were cured.



Figure 1: The stages during curing of mouth parts caused by *S. aureus* or *S. pyogenes*

It seems that there is some bioactive compound, in the root which kills the bacteria (Sinha et al., 2012).

#### DISCUSSION

Many of the plants used today were known to the people of ancient cultures throughout the world and were highly considered their preservatives and medicinal powers. With the recent advancement of research in this field, it has become apparent that many of the species utilized by indigenous people as well as the knowledge of traditional healers has begun to make its mark on society as a possible avenue for curing diseases. Medicinal plant includes those that can be put to culinary and or medicinal use and those associated with orthodox drug such as Fox glove and opium poppy, as well as every day plant such as garlic (Serrentino, 1991).

Recently most of the research conducted in traditional medicines has shown that some remedies obtained from traditional healers are very effective in spite of the fact that there is no effective justification. The greater part of the traditional therapy involves the use of plant extracts on their active principle (WHO, 1993).

In this review, it was found that no report of seed germination of the plant *Acalypha indica* (L). But our experiment on seed germination of *A. indica* seems that the dormancy was due to seed coat induced phyto- inhibitor and an imbibitions of seed in water, must remove these phyto-inhibitors which are mostly water soluble, were washed out, enabling the seeds to germinate.

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.

In Siddha medicine the plant *Acalypha indica* (L) is used in child emesis or purgative or may be used in treatment over skin infection, ulcers, poisonous bites, painful arthritis, or used as a laxative.

In Ayurveda, leave juice of *Acalypha indica* is used as expectorant and is useful in chronic bronchitis, asthma and consumption. Powdered leaves are used in bed sores. Besides, it has many uses in different diseases.

There has been an increasing incidence of multiple drug resistances in human pathogenic micro-organisms in recent years largely due to indiscriminate use of commercial antimicrobial drugs commonly employed on the treatment of infectious diseases. This situation coupled with the undesirable side effect of certain antibiotics and the emergence the previous uncommon infections are serious medical problems. Progress in antimicrobial drugs, has introduced many antibiotics most of which are non-toxic, though all have side effects (Osler, 1983; Shafiei et al., 1992). Hence, despite significant value of antibiotics, the increase of bacterial resistance has restricted their clinical applications (Yurdakok et al., 1997).

Hence *Acalypha indica* was chosen for the study to investigate the bactericidal activity against different pathogenic Gram positive and Gram negative bacteria. The acetone soluble and insoluble fraction of methanolic extract exhibited prominent antimicrobial activity, especially on gram positive bacteria.

In this case, negative result of antibacterial activity on Gram negative bacteria, up to 30 µg/µl of ethanolic leaf extract of *A. indica*.

Based on the current findings, it can be concluded that this plant has potential antifungal properties thus providing a scientific basis for utilization of the plant in herbal medicine for treatment of fungal infection. This antifungal property is definitely proved by the presence of Clotrimazole- a novel antifungal compound in the leaf, stem or root extract of *A. indica*.

From these above mentioned reports, it has been proved that, *A. indica* plant- root, stem and leaves contain different important bioactive compounds which has properties like, antibacterial and antifungal activities. These bioactive compounds need further biochemical analyses to find out its chemical nature. Besides, the plant *A. indica* has several important uses in (a) post ciotal antifertility activity in rats (b) Antivenom properties against *Viper russelli* (c) Haemolysis in rabbits (d) Antimalarial activity against *Anophelis stephensisii* (e) Analgesic and anti-inflammatory effect on rat (f) α-amylase inhibitory activity on Human (g) Antituberculosis activity against *Mycobacterium tuberculosis* (h) Neuroprotection and neurotherapeutic effect on *Mascu-*

*las gastrocnemius*- frog (i) Wound healing properties in rats.

Except these above mentioned uses of the important medicinal plant, it is the source of different important phytochemicals like cyanogenic glycoside – Acalyphin, Acalyphamide, Alkaloids, Catechol, Sterol, Flavoniods, Saponins, antioxidants, which have different biochemical impact on human being or other animals.

From these different types of standard points, it is concluded that the plant must be preserved ecologically and *in vitro* cultures of the plant or plant parts must be done mainly of its medicinal uses.

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