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ACALYPHA INDICA – A BOON TO MANKIND

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ABSTRACT

For quite a long time, medicinal plants are being utilized as solution for different afflictions all through the globe. Acalypha indica is a type of plant having catkin sort of inflorescence. It happens all through tropical Africa and South Africa, in India and Srilanka, just as in Yemen and Pakistan. This plant is held in high regard in customary Tamil siddha medication as it is accepted to revive the body. Pharmacological examination has indicated that the plant has strong antibacterial, antifungal, against – provocative, hostile to – osteoporotic, cell reinforcement, neuro defensive, injury mending, post – coital antifertility exercises. India formally perceives more than 3000 plants for their therapeutic worth. It is for the most part assessed that more than 6000 plants in India are being used in conventional, people and natural medication. **AIM:** This article plans to give a thorough audit to sum up the current examinations on ethnomedicinal rehearses, phytochemistry, pharmacological investigations and a possible investigation of Acalypha indica in various areas around the planet. **METHODOLOGY:** The material used to survey the antibacterial action of acalypha indica is from 1904 to 2020. The information was gathered from online diaries, magazines, and books, which were all distributed in English, Malay and Indonesian. Web crawler sites, for example, Google Scholar, PubMed, Science Direct, Research entryway and other online assortments were used in this audit to get data. Diverse examination articles were utilized to report this survey**. RESULTS:** It is gotten from deciduous and blended storm backwoods all through larger pieces of India, rising to 1300 m in external Himalaya, is generally utilized in conventional therapeutic arrangement of India has been accounted for to have hepatoprotective, calming, antitussive, antifungal and furthermore used to check wounds mending and antibacterial.: It is known as a rich wellspring of tannins, flavonoids and glycosides. **CONCLUSIONS**: The incalculable

restorative properties and helpful employments of acalypha indica just as its Phytochemical examinations and its antibacterial action demonstrate its significance as an important therapeutic plant. (Arulraj et al, 2017).

KEYWORDS: Acalypha indica, Medicinal properties, flavonoids.

INTRODUCTION

Traditional systems of medicines have always important roles in meeting global health care needs. India has a peculiar feature of having six recognized systems of medicine: Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy. The current governing system of Modern medicine or Allopathy has slowly but surely developed and over the years come to be give a positive response through scientific research and execution. However, the fundamental basis for its development lies in traditional medicine and remedy. (Naga Lakshmi et al, 2015) Civilization has changed and with it has come the introduction of more advanced techniques and methods, leading the next generations to tend to choose modern treatment over conventional treatments. The information related to conventional treatments are gradually vanishing since the previous generations are getting older and dying without successors. This knowledge is passed on to the next generation, through experiments and observation and oral teaching. Therefore, it is crucial to have proper documentation from the extant practitioners since conventional treatments are an alternative path to treating various types of human diseases. Traditional or conventional medicinal practices based on natural plants have been recognized by the World Health Organization (WHO, 2002) as reliable medicinal sources for therapeutic activities. The medicinal plants are available around backyards, settlements, spreading along roadsides, and house compounds. (Sudhakar et al, 2020).

Plants produce a diverse range of bioactive molecules, making them a rich source of different types of medicines. The most important of these bioactive constituents of plants are alkaloids, tannins, flavonoids and phenolic compounds. These substances are usually found in several parts of plants like root, leaf, shoot and bark. More than 80% of modern drugs are derived directly from sources of plants and microbes. Bioactive compounds as they contain therapeutic and their complex nature will able to interact with mammalian cell targets. Phytochemicals naturally isolated from the medicinal plants (MAPs) are used specifically in drug industries. However, these Phytochemicals' have certain limitations of low absorption, high toxicity, and other side effects, bioavailability and efficacy. Irrespective of the

advantages of synthetic, combinatorial chemistry and molecular modelling, they remain an important source for new drugs discovery.(Sudhakar et al, 2020).

Acalypha indica is one of weed plants that contain important medicinal values for human health applications. It can be found commonly in India, Sri Lanka Thailand and Pakistan. The extracts of various parts of the plant, leaves, roots and stem parts are used for medicinal purposes to treat various diseases such as the eye infections, respiratory problems, rheumatism, and skin problems and to decrease blood sugar level. Different extraction methods are used for obtaining active components from Acalypha indica. Generally, Soxhlet extraction has a high efficiency and accuracy but the thermal stress might degrade target photochemical components. Acalypha indica it is a common annual herb, found mostly in the backyards of houses and waste places throughout the plains of India. Acalypha indica is a traditional medicinal plant, well-known by older generations in many countries, particularly in Africa and Asia. It grows well in most parts of west and south of Africa northeast, including Somalia, Ethiopia and other regions. The plant can also be found in most wet, tropical and temperate countries in Asia, Europe and both North and South American regions. It grows as a weed in bushes, backyards, alongside roads and other places such as home and crop premises. Many international manuscripts on Acalypha indica were published from Indian region because this plant has a close connection with Ayurveda, Siddha and Unani medicinal practices executed by older Indian generations. (Sudhakar et al, 2020).

Fig 1.

Plant profile

Scientific name: ***Acalypha indica***

Fig. 2.

Table 1: Taxonomic classification.

Kingdom:	Plantae
Unranked:	Angiosperms
Unranked:	Eudicots
Order:	Malpighiales
Family:	Euphorbiaceae
Genus:	Acalypha
Species:	A. Indica

Table 2: Vernacular names.

Bengali:	Muktajhuri, sveta-basanta.
Hindi:	Kuppikhoksli, kuppu, khokali.
Kannada:	Kuppigida.
Tamil:	Kuppivaeni, kuppaimeni.
Telugu:	Kuppichettu, harita-manjiri, kuppinta, muripindi
Malayalam:	Kuppameni.
Sanskrit:	Haritamanjari.

Taxonomy

There are seventeen synonymous names related to this plant species according to theplantlist.com; these include:

Acalypha bailloniana Müll.Arg.; Acalypha canescens Wall.; Acalypha caroliniana Blanco; Acalypha chinensis Benth.; Acalypha ciliata Wall.; Acalypha cupamenii Dragend.; Acalypha decidua Forssk.; Acalypha fimbriata Baill.; Acalypha indica var. bailloniana (Müll.Arg.)

Hutch.; Acalypha indica var. indica.; Acalypha somalensis Pax; Acalypha somalium Müll.Arg.; Acalypha spicata Forssk.; Cupamenis indica (L.) Raf.; Ricinocarpus baillonianus (Müll.Arg.) Kuntze; Ricinocarpus deciduus (Forssk.) Kuntze and Ricinocarpus indicus (L.) Kuntze. There are two invalid synonymous names for this plant (Acalypha canescens Wall. and Acalypha ciliata Wall.) and one illegitimate name (Acalypha caroliniana Blanco). The accepted name to refer to this plant is Acalypha indica L. (The Plant List, 2013). The hierarchical taxonomy list of Acalypha indica had been verified by the Integrated Taxonomic Information System and the common name for this species in English is Indian copperleaf (Integrated Taxonomic Information System, 2015). This plant belongs to the Acalypha genus which is classified as the fourth largest genus in Euphorbiaceae family. Most of the plants from this family are used as medicinal herbs in Asian and African regions (Seebaluck et al., 2015).

Acalypha indica is a small annual erect herb plant that grows up to 0.6 m (Stone, 1970), 0.35 m to 0.75 m (Kirtikar, 1918), 0.3 m to 1.0 m (Takle et al., 2011) and is capable heights of reaching 1.5 m to 2.5 m (Schmelzer, 2007). It is a taproot type plant and its leaves are 2.5 – 7.5 cm long with 2.0 – 4.5 cm broad either ovulate or rhombic ovulate shape. The leaves have acute or sub obtuse crenate-serrate, glabrous thin and base cuneate. Their petiolate is usually longer than the blade, slender, and stipulate minute (Kirtikar, 1918; Stone, 1970). The leaves of the Acalypha indica are simple and arranged spirally; 0.02 – 12.00 cm petiole long; blade broadly ovate to ovate-lanceolate; 2 – 9 cm × 1 –5 cm; base cuneate; apex acute; margins toothed; membranous; sparingly short hairs to almost glabrous is nature on both surfaces; hairier along the midrib; 5-veined at base and with 4 to 5 pairs of lateral veins (Schmelzer, 2007). One month after germination, the stem starts to turn woody as it matures. The stem is sparing to densely hairy (Schmelzer, 2007). The branches are numerous, long, ascending, and finely pubescent (Saha et al., 2011b).

The flower of the Acalypha indica is arranged in numerous lax, erect, elongated, auxiliary spikes, and clusters near the summit of the spikes. The female is in white color, scattered, and surrounded by a shortly pedunculate large leafy dentate cuneiform with many nerves bract that is approximately 6 to 8 mm in diameter (Kirtikar, 1918). The flowers are sessile on erect axillary spikes longer than the leaf. The male flowers are minute and crowded distally with 8 stamens, while the female flowers are scattered along inflorescence axis, each is subtended by a conspicuous semicopula foliaceous toothed green bract, nearly 7 mm long (Stone, 1970).

The inflorescences are in axillary, solitary or paired spike reaching up to 6 –10 cm long. The lower 75% comprises of laxly arranged female flowers and the upper part with densely congested male flowers that are usually terminated by a female flower; bracts in female flowers transversely ovate to almost orbicular, 0.5 – 1cm × 1 – 1.5 cm, toothed, each subtending 1 – 2 or 5 flowers. The flowers are unisexual, sessile and petals absent; male flowers with 4-lobed, minute, granular dotted, greenish calyx and stamens 8; female flowers with 3 triangular-ovate, ciliate sepals, ovary superior, 3-celled, slightly 3-lobed, styles 3, fused at base and fringed (Schmelzer, 2007). The fruits of the Acalypha indica are small and hairy. The seeds are minute, ovoid in shape and pale brown in color. The capsules are small, hispid, and quite concealed by the bract (Nadakarni, 1982).

The fruit is a 3-lobed capsule with 1.5 mm × 2.0 mm, granular dotted, short-hairy, splitting into 3 cocci, each 2-valved and 1-seeded. The seeds are ovoid, c. 1.5 mm × 1.0 mm, smooth, gray, caruncle linear and appressed with the terminal flower producing 1 seed (Schmelzer, 2007). In the early stages of seed formation, its color changes from greenish white into a completely brownish or gray color depending on its maturity.(Sudhakar et al, 2020)

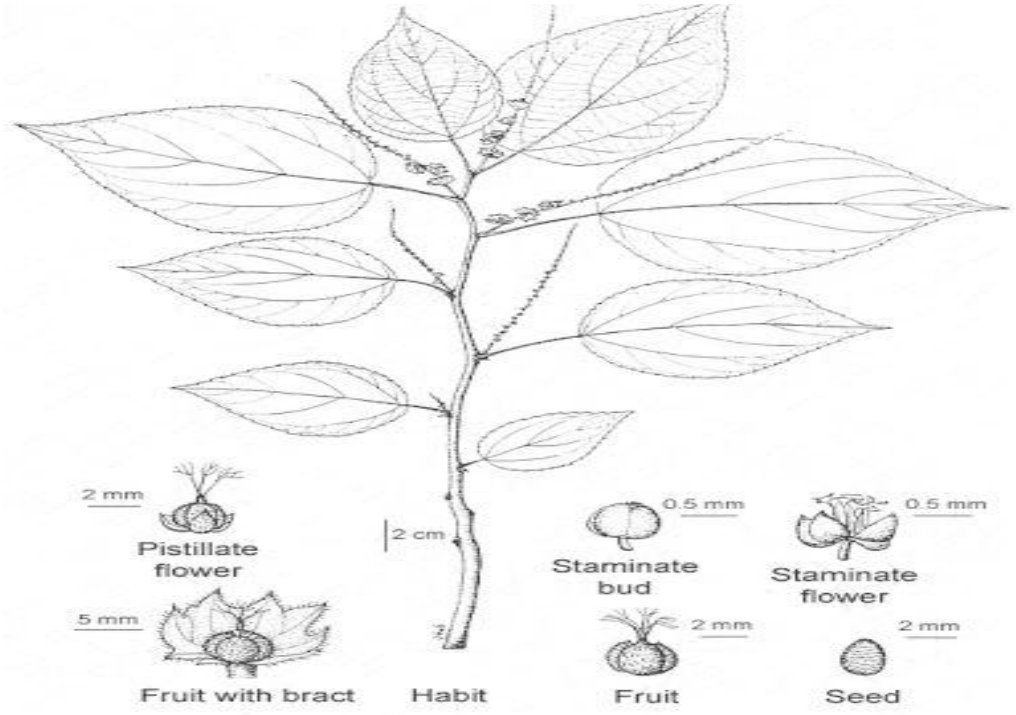

Fig 3.

Distribution

Acalypha indica grows naturally in wet, temperate, and tropical areas along the equator cross continental of Asian, Africa, Europe, South and North America and Australia. The Discover

life (2015) database reported the spread distribution of Acalypha indica in the most wet and warm tropical regions especially in Asia, from t India to Australia. The Indian people have the most documented records of plant utilization for their traditional medicines (Martin, 1995; Savithramma et al., 2007). Meanwhile, many Australians recognized this plant in their area but are less inclined to consume it (Scaffidi et al., 2016). Acalypha indica also can be found in the Arabia Gulf region based on the report that they consumed this plant as a food (Marwah et al., 2007). Acalypha indica is also a common weed found in south Nigeria and West Africa (Burkill, 1994). Schmelzer (2007) reports levels of high distribution particularly in Africa from the central part of equator down to the southern of Africa through Ethiopia, Sudan, DR Congo, South Africa, Somalia, Kenya, Mozambique, Tanzania, Zambia, Nigeria and others.(Sudhakar et al, 2020)

Table 3: Ethnomedicinal properties.

Uses	Plant parts used	country practiced	References
Anthelmintic	Leaf paste with lime juice Powder of dry leaves Decoction with garlic	India	Mohan et al., 2012
Anti-parasite	Leaves are ground with either common salt, quicklime or lime juice for external uses	India	Mohan et al., 2012
Aphrodisiac	Dried leaves decoction	Malaysia	Vimala, 2013
Asthma	Decoction, 50 ml taken per day, for 1 week by mouth	India	Savithramma et al., 2007
Bronchitis	Whole plant is crushed and the juice is applied	India	Senthilkumar et al., 2006
Constipation	Leaves ground into a paste and made into a ball-shape. The paste is introduced into the rectum to relax the sphincter and produces relief motions	India	Saha et al., 2011b
Dermatology ailment	1. Leaves 2. Dried leaves poultice 3. Leaf juice is prepared with either oil or lime	India	Paindla et al., 2014 Steyn, 1938 Lingaraju et al., 2013
	Leaf juice	India	Paindla et al., 2014
	Paste is prepared by using nine leaves of Acalypha indica and pepper to the two gram size tablet.	India	Rampilla et al., 2015
	Paste is prepared by using leaves and black cuminum then applied as a balm.		

	Crush leaves poultice is mixed with Cardiospermum halicacabum	Mauritius	Ameenah Gurib-Fakim, 1996; Gurib-Fakim, 2011; Lingaraju et al., 2013; Mutheeswaran et al., 2011; Rastogi et al., 1990; Seebaluck et al., 2015
Diarrhea	Leaves, roots and seeds	Bangladesh	Das et al., 2012
Ear ache	Leaf decoction	India	Jayaprakasam et al., 2013; Mohan et al., 2012; Seebaluck et al., 2015
	Whole plant decoction given orally	Nepal	Singh et al., 2012
Emetic	Leaf juices	India	Ghani, 2003; Mohan et al., 2012
Epilepsy	Leaves ground with garlic, pepper and leaves of Leucas aspera, extract given orally	India	Reddy et al., 2010; Sharma et al., 2013
	Leaves mixed with Cardiospermum halicacabum and boiled in Azadirachta indica oil. Extract is consumed	India	Henry et al., 1996; Sharma et al., 2013
Expectorant	Whole plant	India	Jayaprakasam et al., 2013
Fever	Root	India	Rastogi et al., 1990
Gum and teeth disease	Powder or decoction	India	Divya et al., 2014
	Whole plant decoction given orally	Nepal	Singh et al., 2012
Headache	Leaf decoction	India	Jayaprakasam et al., 2013
	In congestive headache, a piece of cotton saturated with the pressed juice of the plant or leaves is inserted into each nostril. They say it can relieve a headache by causing a hemorrhage from the nose.	India	Saha et al., 2011b
Hemorrhoids	Crushing and leaf decoction	Mozambique	Ribeiro et al., 2010
Insect bites	Leaf poultice	India	Kirtikar, 1918; Nadakarni, 1982
Laxative,	Root infusion	India , Malaysia	Mohan et

			al.2012;Nadakarni, 1982; Vimala, 2013
	Grinding, decoction and maceration	Mozambique	Ribeiro et al., 2010
Lowered Blood Sugar	Root extract	India	Chopra et al., 1956
Mouth ulcer	Whole plant decoction	Malaysia	Vimala, 2013
	Whole plant decoction	Malaysia	Malaysia Peninsular Forestry Department, 2017
Pimples	Leaves are ground with ginger	Malaysia	Malaysia Peninsular Forestry Department, 2017
Rheumatoid arthritis	Fresh leaf juice	Nepal	Singh et al., 2012
Syphilitic ulcer	Leaf decoction	India	Jayaprakasam et al., 2013
Wound healing	Blend with Ficus benghalensis, Morus alba and Tridax procumbens	India	Basha et al., 2011
	Eat	Oman	Marwah et al., 2007

Most of the practices come from people in the Asian and African regions as shown in Table. Some people in India are a regular consumer of this plant since it is part of the Ayurveda practice. Meanwhile, other countries use this plant as part of their treatment but usage is minimal. The implementation of Acalypha indica plant for ethnomedicinal purposes can be divided into three main parts; whole plant, leaves and roots. The method of applying this plant for treatment as a single use or in a combination with other ingredients also plays an important role and needs to be discussed. The plant condition during treatment, fresh or dry, could also be an important factor in its therapeutic effectiveness. Even though the plant is known for its therapeutic purposes, there are some people who consume this plant as a food prepared either as a green leafy vegetable or a fried flour snack in their daily meal (Schmelzer, 2007). 64% of ethnomedicinal practices consume the leaf parts of the plant, followed by the whole plant (24%) and the root (12%). The leaves are the most abundant part and easy to be separated, compared to the root, stem, seeds, and flowers. (Sudhakar et al, 2020).

The leaves of the Acalypha indica can be used as an anthelmintic (Mohan et al., 2012), for asthma (Savithramma et al., 2007), for diarrhea (Das et al., 2012), as an emetic (Ghani, 2003; Mohan et al., 2012), as a laxative (Ribeiro et al., 2010), for rheumatoid arthritis (Singh et al.,

2012), syphilitic ulcer (Jayaprakasam et al., 2013) and wound healing (Marwah et al., 2007). There are two oral methods to consume the leaves which are in a leaves decoction or eaten raw. Besides, this plant also can be used for external therapeutic applications such as constipation (Saha et al., 2011b), dermatology ailment (Ameenah Gurib-Fakim, 1996; Gurib-Fakim, 2011; Lingaraju et al., 2013; Mutheeswaran et al., 2011; Paindla et al., 2014; Rampilla et al., 2015; Rastogi et al., 1990; Seebaluck et al., 2015; Steyn, 1938), ear ache (Jayaprakasam et al., 2013; Mohan et al., 2012; Seebaluck et al., 2015), epilepsy (Henry et al., 1996; Reddy et al., 2010; Sharma et al., 2013), ganglion (Aboubaker et al., 2013), gum and teeth disease (Divya et al., 2014), headache (Saha et al., 2011b), hemorrhoids (Ribeiro et al., 2010), insect bites (Kirtikar, 1918; Nadakarni, 1982), pimples (Malaysia Peninsular Forestry Department, 2017) and wound healing (Basha et al., 2011; Jayaprakasam et al., 2013). In some practices in India, the whole plant is consumed. They use the whole plant instead of the leaves to cure bronchitis by crushing the plant for fresh juice (Senthilkumar et al., 2006). The whole plant is also beneficial in treating ear aches and oral diseases in Nepal (Singh et al., 2012), expectorant in India (Jayaprakasam et al., 2013) and mouth ulcers in Malaysia (Malaysia Peninsular Forestry Department, 2017; Vimala, 2013). In Malaysia, the whole and dry Acalypha indica plant is served as a tea beverage for aphrodisiac purposes (Vimala, 2013). Few people use the root decoction for treating some illnesses like diarrhea (Das et al., 2012), fever (Rastogi et al., 1990), as a laxative (Mohan et al., 2012; Nadakarni, 1982; Vimala, 2013) and for low blood sugar (Chopra et al., 1956) in their practices. Notably, each part of this plant has certain functions for therapeutic properties based on ethnomedicinal practices. Therefore, further scientific study is required to investigate its performance during treatment. (Sudhakar et al, 2020).

Some people mix this plant with other ingredients or remedies to enhance the treatment efficiency on a disease. Approximately 58% of practices prefer to combine this plant with another herb to increase the effect. For example, the people in India use Acalypha indica leaves with lime juice or garlic for anthelmintic treatment (Mohan et al., 2012). Meanwhile, the leaves can be mixed together with oil and other herbs such as black cuminum and Cardiospermum halicacabum for external application to treat any disease related to skin ailment (Ameenah Gurib-Fakim, 1996; Gurib-Fakim, 2011; Lingaraju et al., 2013; Mutheeswaran et al., 2011; Rampilla et al., 2015; Rastogi et al., 1990; Seebaluck et al., 2015). A similar treatment process with different herbs (Leucas aspera, Cardiospermum

halicacabum and Azadirachta indica oil) is used by people in India) to treat epilepsy (Henry et al., 1996; Reddy et al., 2010; Sharma et al., 2013). (Sudhakar et al, 2020).

The ethnomedicinal practices more commonly involve Acalypha indica (91 %) rather than the dry form (9%). The fresh plant contains completely natural phytochemicals that are useful for all therapeutic activities including fatty acid, volatile compound and essential oil. From observing ethnomedicinal practices, it was found that the volatile compound might be responsible for the therapeutic activities. The fresh Acalypha indica leaves produce a strong smell during the drying process showing the presence of volatile compounds from evaporation. A weight loss of 80% after the drying process demonstrates the high moisture content and volatile compound of this plant. Nevertheless, the remaining phytochemicals in the dry plant are beneficial in curing other therapeutic problems such as anthelmintic (Mohan et al., 2012), skin problems (Steyn, 1938) oral diseases (Divya et al., 2014), and act as an aphrodisiac (Vimala, 2013).

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. (Sudhakar et al, 2020).

The application of Acalypha indica in ethnomedicinal practices mostly occurs in Asian and African regions, and even though this plant grows in wet, hot, and temperate tropical climate, there are no records found outside either region. Many local places list this plant in their database archives but not many people use this plant as medicine. The optimum use of this plant is varied based on the location and local knowledge of practices. This plant may be also taken as a means of dieting when consumed as a leafy green vegetable rather than in medicinal application like people in India and Oman (Marwah et al., 2007; Schmelzer, 2007).

In Malaysia, some manufacturers process the dry leaves of this plant and sell it to the public as a healthy drink (Malaysiakini, 2006); who also believe this plant can be used to stimulate their libido, especially for men. However, until now there has been no scientific evidence to prove this claim and the people are relying on the information given by their ancestors.

Acalypha indica also can be used to treat insect bites (Kirtikar, 1918; Nadakarni, 1982). Insect bites causes inflammation of the skin, blisters and irritation depending on the types of

poison released during the sting. Since Acalypha indica can cure ailments related to the skin, it is also applied to insect bites to reduce soreness. The leaves also contain good anti-bacterial activity, anti-fungal activity and antioxidant phytochemicals which are useful in protecting the skin from external hazards. The released fluid from crushed leaves is useful as a lubricant for child constipation treatment by applying the small ball-shaped made from leaves into the rectum. Additionally, the fluid is composed of an oily compound to loosen the rectum for feces release and protect the wounded rectum wall. An adult with hemorrhoids can also use this fluid by rubbing it around the rectum. The phytochemicals inside this plant can treat and contract the hemorrhoids through wound healing activities. Furthermore, the fresh leaves possess a high amount of volatile chemicals to treat headaches, epilepsy, earaches and as an expectorant. Since Acalypha indica has an anti-bacterial property, wound healing activities, is edible and safe to consume, people prefer to use this plant to treat sickness related to gum and teeth. (Sudhakar et al, 2020).

Phytochemical study

The fresh Acalypha indica plant has a wide variety of nutrients such as carbohydrates, proteins, vitamins, and lipids. They decided to prepare its documentation with detailed observation of essential and non-essential heavy metals content as a part of the herbal standardization preparation. Acalypha indica has high iron content, followed by copper, nickel zinc, and chromium which are useful for patients with mineral deficiencies problems. This plant has a high moisture content of up to 90% and a total ashes value of 18% suitable for body hydration. As a leafy low-cost vegetable, this plant can provide a more balance in nutrients at minimal costs. (Sudhakar et al, 2020).

Researchers have studied and listed the secondary metabolites in Acalypha indica plant parts as shown in Table. These studies show some relevance in the interrelationship between ethnomedicinal practices with the respective parts of the plant. The list of phenolic compounds derived from this plant, corilagin, geraniin, glucogallin and chebulagic acid were useful as antioxidants. (Joy et al,2010) Meanwhile stated that there were five compounds from the ethanolic leaf extract of the leaves which acted as antioxidants. Ellagic acid, gallic acid, 16 α, 17-dihyroxy-ent-kauran 19-oic-acid, 4,4′,5,5′,6,6′ hexa hydroxy diphenic acid and kauren- 18-oic-acid can be found inside this plant.(Sanseera et al,2012) Indicated active inhibition of anti-cancer activity against small cell lung and breast cancer by the quebrachitol

compound found in leaves. This compound is responsible for healing respiratory problems such as bronchitis and asthma shown in Table.

Table 4: Phytochemical contents in Acalypha indica L. from different parts of the plant (Leaf, root and flower).

Phytochemical	Plant part	References
Acalyphamide	Whole plant	Duke., 2016
Acaindinin	Leaf	Ma et al., 1997
Acetonylgeraniin	Whole plant	Ma et al., 1997
Aurantiamide	Leaf	Raj et al., 2000
Caffeic acid	Whole plant	Murugan et al., 2015
Corilagin	Leaf	Ma et al., 1997
Cysteine	Whole plant	Hussain et al., 2013
Ferulic acid	Leaf	Murugan et al., 2015
Gallic acid	Whole plant	Joy et al., 2010
Stigmasterol	Root	Raj et al., 2000
Resin	Leaf	Azmahani et al., 2002
Syringic acid	Root	Murugan et al., 2015
Tectoquinone	Whole plant	Duke., 2016
Triacetonamine	Leaf	Azmahani et al., 2002
3,3’ Methylene bis (4-hydroxyl coumarin)	Root	Murugan et al., 2015

The plant substance constituent a cyanogenetic glucoside, kaempferol, triacetoneamine, a base & acalyphine, an alkaloid. It too contains the acalyphamide ,amide along with a few further 2- methylanthraquinone , amides, y-sitosterol, beta-sitosterol, tri-o-methyl ellagic acid & stigmasterol, beta-sitosterol glucoside, quinine, tannin, resin, n-octacosanol, & essential oil. Acalyphine is awfully cooperative within the action of sore gums. Plant contain substance, their structure & their specific functions has been described in this study . Plant Contain Antimicrobial, antimutagenic, antidiabetic, antitumorous, cytotoxic, antibiotic-chemotherapeutic, anti-teratogenic properties which make it important medicinal plant for Medicine purpose. (Sudhakar et al, 2020).

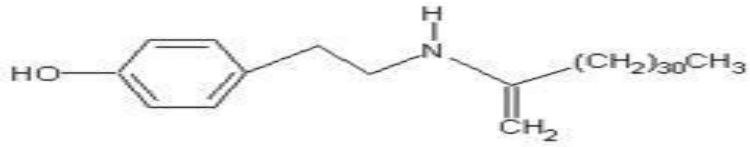

Fig 2: Chemical Structure of Acalyphamide

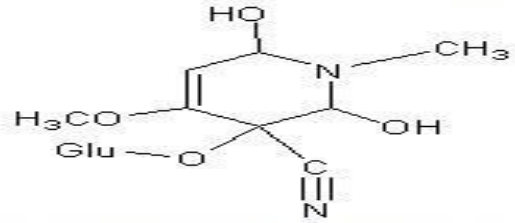

Fig 3: Chemical Structure of Acalyphine

Table 5: Bioactive complex of Acalypha indica L. along with its organic properties

complex	Possible organic properties	References
9-tricosene	Pesticides , insect pheromone	(Lin CC et al,2015) (Kavran et al, 2015)
Phytol	Antimicrobial ,antimutagenic, antidiabetic, antitumorous , cytotoxic, antibiotic chemotherapeutic, anti-teratogenic	(Islam MT et al, 2015)
Loliolide	Inhibitor of cellular senescence during human , dermal fibroblast , inhibitor of hepatitis C virus access	(Chung CY et al, 2016)
Docosanol	Antiviral agent of herpes simplex virus	(yang et al, 2015)
Octacosanol	Growth along with lying performance inside pourty , scheming of blood metabolism, proliferation moreover migration of human umbilical vein endothelial cells	(Leung DT & Sacks ,2004) (Peng K et al)
9,12-octadecadienoic acid (Z,Z), methyl ester	Anticancer	(Kumar NR et al, 2012)
Hexane dioic acid, bis(2-ethylhexyl) ester	Antibacterial activity	(Ge S et al, 2015)
1-triacontanol	Promotion of plant growth with flowering	(Peng W et al ,2014)
3,7,11,15-tetramethyl 2-hexadecen-1-ol	Drug resistance reverse agents	(Khandaker et al, 2013)
Dihydroactinidiolide	Cat attractant , photo acclimation during plants ,pheromone intended for insects ,photo acclimation into plant	(Upadhyay et al, 1860)
1-Eicosanol	Antibacterial with antifungal activity ,antitumor activity in vitro plus in vivo in mice model	(albone ES 1975) (Shumbe L et al,2014)
Tricosane	Insect pheromone ; pesticides	(figueiredo et al, 2014)

5,10- Diethoxy-2,3,7,8-tetrahydro-1H,6H-5,10-Diethoxy-2,3,7,8-dipyrrolo[1,2-a;1',2'-d] pyrazine	Antifungal activity	(Kavitha et al,2009)

Pharmacological activity

Analgesic

Acalypha indica has analgesic properties as proven by conducting in vivo studies on mice. (Rahaman et al, 2010) They used a writhing reflex method developed by (Vogel.H, 2007) to determine the analgesic activity of the Acalypha indica hexane extract. Acetic acid was used to induce pain right after the extract was orally administered to the mice. The injection of acetic acid will cause trauma to the whole body in two phases; the first phase will release serotonin and histamine while the second phase will involve prostaglandins in the inflammatory exudates in plant extract. (Crunkhorn et al, 1971) Two kinds of concentrations were tested and compared where amino pyrine was set as a positive control. The results were measured by counting the writhing induced within 20 minutes, immediately after the extract and standard were introduced into the mice. The 100 mg/kg and 200 mg/kg of hexane extractions produced up to 61.1% and 67.2% of writhing inhibition, respectively. The effects showed adequate inhibition activities compared to the use of standard amino pyrine with a 79.9% writhing inhibition. (Rahaman et al, 2010)The hexane extract disrupted the first phase of inflammation formation by inhibiting the release of serotonin and histamine. The anti-inflammation, antioxidant and phytochemicals in the fresh plant may be responsible for this inhibition.

Anthelmintic activity

An anthelmintic is a drug used to expel parasitic worms that usually intrude in the human body parts. The parasitic worm can penetrate animal and human bodies through any available cavities like the skin and mouth. An anthelmintic drug derived from easily available herbal medicine is encouraged since it can save costs in treatment.(Chengaiah et al,2009) Both used a similar method to study the anthelmintic activity (Ranju et al,2011) From their studies, the extract from methanol and water could kill Pheretima posthuma 20 minutes after its introduction and completely killed after 40 minutes. In these study (Chengaiah et al, 2009), the concentration of 100 mg/ml methanolic root extract was dissolved and tested in a medium.

Anti-bacterial activity

Most therapeutic studies that have been reported on Acalypha indica are related to the anti-bacterial activities. There is conflict when identifying the inhibition method, positive and negative controls, and experiment preparation methods because the studies differ from one another. The classification to identify whether the extract is either active or inactive needs a justification. One of the classification methods is through measuring the diameter of the zone of inhibition. From the diameter, the small number represents slightly active activity while the high number will be noted as very active.(Junior et al,2000) Then, the results are expressed in the form of inhibition percentage where between 0 and 30% it is considered weak, 31 to 70% is considered as active and the inhibition over 71% is very active. Thirteen Gram-positive bacteria including Bacillus, Streptococcus, Enterococcus, and Staphylococcus species have been tested from those studies. For Gram-negative bacteria only eleven bacteria were tested on the various polarities of Acalypha indica extractions at present. In conclusion for anti-bacterial activity, the fresh plant approach is suggested instead of a decoction to treat many diseases related to Streptococcus such as pus formation and inflammation. Specific medicinal compounds in Acalypha indica responsible for bacterial inhibition are not really discussed by most researchers. They only discussed a certain group of phytochemicals or secondary metabolites in plants, which are responsible for anti-bacterial activities and do not explain the mechanism of inhibition. Besides, the flavonoids, tannins, polyphenol, protein and saponin also play an important role in inhibiting and retarding bacterial growth. (Batubara et al, 2016).

Considering the world- wide TB issues, there is an earnest need to develop moderately economical new medications to treat this destructive infection. Natural products isolated from plants have assumed a vital part in revelation of medications against irresistible ailments. In the present study, thirty ligand molecules which were present in the plant Acalypha indica were docked with the selected target proteins of Mycobacterium vi 4RHU, 1W30, 2A7S, 1N2B, 1F0N. Among them Potassium Brevifolincarboxylate had a significant inhibitory activity with 1N2B protein forming bonds at a very low energy value, thus forming a stable complex. The other active compounds were found to be beta Glucogallin and Caffeic Acid. The active substances from the extracts of Acalypha indica which exhibited promising activities is reported for the first time. These can serve as promising candidates to develop new drugs to combat M. tuberculosis. (Deepesh et al, 2018).

This work was designed to investigate the preliminary phytochemical, antibacterial and GCMS analysis of ethanol extract of the plant. Phytochemical screening of leaves extract revealed the presence of alkaloids, tannins, steroids, saponins flavonoids, glycosides and phenolic compounds. The ethanol extract of leaves was found to be exhibit activity against Escherichia coli, Salmonella typhi, Pseudomonous aeruginosa and Staphylococcus aureus. Six compounds were identified by GCMS analysis are 1H-Pyrrole-2,5-dione,1- ethynyl-, 3,8-Nanodiene-2-one,(E)-, Proline,3,4- didehydro-, 4-Amino-3-methoxypyrazolo[3,4-d]pyrimidine,Propanenitrile,3-(5-diethylamino-1- methoxy-3-pentynyloxy)- compounds. Findings from current study support the use of Acalypha indica in traditional medicine for treatment of various bacterial infections and can be used as multi resistant drug in future. (Mohan et al, 2012).

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. (Murugan et al, 2012).

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 IC50 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. (Ruslan et al, 2015).

Acalypha indica were investigated against two strains of Human pathogenic bacteria. A total of 15 pus samples were collected from Namakkal private hospital, among that two strains were isolated as Staphylococcus aureus and Pseudomonas aeruginosa. Isolation and identification of bacterial isolates by using standard biochemical tests. The above isolated organisms were tested for their sensitivity towards the Acalypha indica medicinal plant leaves extract by disc diffusion and Agar well methods. In this study the highest antibacterial activity was observed in water extract of Acalypha indica than compared with acetone extract. Inhibitory effect of medicinal plant against Staphylococcus aureus in well diffusion is (17mm), and Pseudomonas aeruginosa is (20mm) in water extract. In acetone extract 7mm, 9mm inhibitory zone showed by Staphylococcus aureus and Pseudomonas aeruginosa. (Bharathi et al, 2014).

Anti-cancer activity

Acalypha indica plant extract also has the ability to become an anticancer plant as reported by(Amarnath et al,2014). Three types of cancer cell lines have been tested with Acalypha indica leaf extracts including KB-Oral cavity cancer, MCF7-breast cancer and PC3 human prostate cell cancer. The anti-cancer activity was determined through MTT assay method. The ethanolic extract of Acalypha indica inhibited MCF7-breast cancer with an inhibition concentration (IC 50) value of 35 µg/ml. Two standards have been used in the assay for comparison which was doxorubicin and ellipticine. The IC 50 value for doxorubicin and ellipticine were 8.8 µg/ml and 0.5 µg/ml, respectively. The MCF7- breast cancer and the KB-Oral cavity cancer were considered nonreactive with the methanolic extract since the inhibition concentration exceeded 50 µg/ml.(Chekuri et al,2017) In addition, a recent study

has revealed that the quebrachitol could participate in several important mechanisms as potential anti-cancer drugs either via arrest or reverse pathways. (Wang et al, 2017).

Extracts of Acalypha indica Linn. (aerial parts) were investigated for antioxidant activity, anticancer activity, and cytotoxicity. The extracts showed a non-cytotoxic response against Vero cells (African green monkey kidney). The anticancer activity of the extracts was tested using the Resazurin Microplate Assay (REMA). The methanol extract showed anticancer activity against NCI- H187-Small Cell Lung Cancer with an IC 50 of 25.00 μgmL -1 . In addition, the hexane, chloroform, and methanol extract also showed significant antioxidant activities with an IC 50 of 6.19, 5.70, and 7.79 mg/mL, respectively, by means of the DPPH radical scavenging assay. The hexane, chloroform, and methanol extract also showed significant antioxidant activities with an IC 50 of 6.13, 6.31, and 6.37 mg/mL, respectively, by means of the ABTS radical scavenging assay. Isolation and purification of the methanolic extract of the aerial part produced substantial amounts of L-quebrachitol, which was characterized by 1D and 2D NMR experiments and the MS data. (Sanseera et al, 2012).

Anti-diabetic activity

Acalypha indica has potential as an anti-diabetic activity when the plant is used in the treatment.(Nandhakumar et al,2009) Indicated the hexane and methanolic extract inhibited alpha amylase activity up to7.51% and 65.32%, respectively. Amylase is an enzyme that catalyzes and hydrolyses starch into sugars. A continuity of the study has been carried out by through in vivo tests on rats. Both of them used the diabetes induction method on rats before the plant extract was introduced via oral the blood glucose levels decreased at least 35% after the administration of different plant extracts, followed by decreases in levels of cholesterol, urea and triglycerides levels after six hours. The streptozotocin drug was used to cause a rapid destruction of pancreatic β cells which led to impaired glucose-stimulated insulin release and resistance. These are the molecular marker features for type II diabetes studies in rats in in vitro studies. The plant extract to inhibit the destruction of pancreatic β cells will determine whether the medicine is useful or not. In this case, the whole plant of Acalypha indica can be used as an herb for anti-diabetic activity. This data supports the application of Acalypha indica plant extract as an agent to lower blood sugar by some people in India(Chopra et al,1956). In their practice, the Acalypha indica roots alone is used to treat high blood sugar levels whereas, in the studies, the whole plant has proven to be high

effective. This is possibly due to the root containing small amounts of cyanogenic secondary metabolites compared to the aerial part. (Hungeling et al, 2009).

In this study, the chloroform and hexane extracts of Acalypha indica at different concentrations, showed dose dependent α- amylase inhibition against porcine pancreatic amylase by the in vitro method, whereas the ethanol extract had no amylase inhibition. Further, it was suggested that Acalypha indica may have a beneficial effect in the management of diabetes. (Nandhakumar et al, 2009).

The study concerning to the comparison of hypoglycemic activity of the extract and Acalypha indica Linn. Tablet in mice male ddy strain that has been conducted. The purpose of this study is to compare the hypoglycemic activity of the leaf, herb and root extract and its tablets between pure extracts and extract tablets. Mice were divided into 8 groups, namely Normal Controls (KN), Glibenclamide (G) Leaf Extract (ED), Herbal Extract (EH), Root Extract (EA), Tablets Leaf Extract (TD), Herbal Extract Tablets (TH), and Tablet Root Extract (TA). Measurement of blood glucose level performed at 4 time points; fasting blood sugar (T 0), 30 minutes after the test material (T 30), 30 min after glucose administration (T 30 pc) and 2 hours after glucose administration/post prandial (T 120 pc). The results showed that the group of ED and EA, and TD and TH have hypoglycemic effects that differ significantly by group KN. EH and TA group had hypoglycemic effects that did not differ significantly by group KN. ED had significantly different hypoglycemic activity with EH and EA. There are no significant differences between the hypoglycemic activity of the tablets extract for all groups. Herb extract had significantly different hypoglycemic activity with its tablets. (Junaedi et al, 2014).

Anti-fungal activity

Six kinds of fungi (Aspergillus flavus, Aspergillus niger Candida albicans, Candida glabrata, Candida tropicalis, and Penicillium chrysogenum) have been used to test whether Acalypha indica has an anti-fungal activity or not; these tests were conducted by. (Sakthi et al, 2011) (Selvamani et al,2015) Six solvents were used including hexane, petroleum ether, chloroform, ethyl acetate, methanol, and water to extract the compounds from Acalypha indica. The similar method for anti-bacterial is implemented to categorize the anti-fungal activity of Acalypha indica. As a conclusion, there is still little information on anti-fungal activity from this plant those which are currently available.(Selvamani et al,2015) The phenols and flavonoids in Acalypha indica are expected to be the source of anti-fungal

activity based on the previous studies.(Hnatyszyn et al,2007) For anti-fungal activity, extraction from water like a decoction is recommended since fungi are affected by any photochemical drugs. Raw of the whole plant is suggested to treat fungal infections in the human body.

Anti-inflammatory activity

Acalypha indica plant extract can behave as an anti-inflammatory medicine in the human body. Identified this activity of the Acalypha indica in the long even rats by using ethanolic extract. They used the anti-inflammation method with minor modifications and selected phenylbutazone as the standard drug for this activity. The anti-inflammation effects were comparable with the standard until five hours after the injection of the carrageenan solution.(Rahaman et al,2010)) The anti-inflammation activities from ethanolic extracts are also supported by which resulted in the inhibition of albumin proteinase and denaturation. Both assays showed 85% of inhibition, indicating no protein denaturation when the extract was used. Protein denaturation is one of the indicators for inflammation activity in the human body. The Acalypha indica plant extracts stabilized the membrane by inhibiting hypotonicity-induced lysis of an erythrocyte membrane, analogous to a lysosomal membrane. (Soruba et al, 2015).

Anti-obesity activity

Obesity is one of the significant peril factors for metabolic disorder and syndrome of energy balance and basically well thought out as a disarray of lipid metabolism, which includes hypertension and hyperlipidemia potentially leading to type 2 diabetes mellitus, non-alcoholic fatty liver disease and cardiovascular diseases. (Naik et al, 2019) There are two types of methods done to study the anti-obesity of Acalypha indica plant extract. Conducted a study using different concentrations of ethanolic extract through a weight assessment for 29 days on Albino swiss mice.(Moon et al, 2013) They claimed there was no significant increment in mice weight during the experiment.(Rajasekaran et al, 2013) Furthered the study by using a high-fat content diet together with ethanolic extract on Albino Swiss mice. The mean body weight of the rats on the fifteen day was measured to compare between the standard (Simvastatin) and the 300 mg ethanolic extract. Both groups increased by 34.14% and 34.61% after being fed the atherogenic induced diet, while the group of mice who were only fed the atherogenic induced diet had a high value of mean body weight percentage (39.56%). The ethanolic extract exhibited similar results to the standard drug used in the

experiment. The flavanols inside. Acalypha indica like standard drug (quercetin) also played a key role as a potential anti-obesity drug. (Moon et al, 2013)

Antioxidant activity

There are three types of assays used for antioxidant measurements for measuring the antioxidant activity. The 2,2-diphenylpicrylhydrazyl (DPPH), 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid) (ABTS), and FRAP assays are used to test antioxidant activities from various extracts of Acalypha indica extracts from a certain plant part. As a result, these antioxidant studies are quite inconsistence and dubious. For example, the methanolic extract results showed the antioxidant value from poor to very strong activities. The presented antioxidant results in this review are influenced by how the researchers prepared the sample and where the sample came from. The data is reliable but still significant as a reference for future study. The whole Acalypha indica plant has antioxidant activities, especially the phytochemicals from semi-polar, polar and non-polar groups. (Ruslan et al, 2015).

Hepatoprotective activity

Methanol extract of A.indica aerial parts (300mg/kg) was administered orally to wistar albino rats of either sex (175-225g) in a single daily dose for three days. Thioacetamide as hepatotoxity inducer was administered orally on the second day 30min after the administration of the extract. After 48 hr of thioacetamide administration, the extract showed hepatoprotective activity by decreasing the glutamic oxaloacetic transaminase (GOT), glutamic pyruvic transaminase (GPT), alkaline phosphatase (ALKP) (GOT:140.17± 7.67 IU/L; GPT:84.31± 28.70 IU/L; ALKP: 427.48± 73.38IU/L) compared to silymarin (GOT:152.67± 7.61 IU/L; GPT: 77.71±27.56 IU/L;ALKP: 385.92± 91.27IU/L).(Globin med, Malaysian journal).

Anti-ulcer activity

There are phytochemicals in the methanolic extract of Acalypha indica hat are capable of inhibiting ulcer activity based on the treatment of the Swiss albino rats. They identified the ulcer inhibition activity by studying the reaction of pylorus ligature and swim stress swiss albino rats. In their experiment, two concentrations of Acalypha indica were administered to the rats; 50 and 100 mg/kg per body weight. The standard drug reference for anti-ulcer activity is famotidine with 10 mg/kg per body weight at 10 ml/kg vehicle (5% w/v of acacia). The 100 mg/kg of extract reduced 67.14% of the volume of gastric juice, 59.29% of total

acidity, 53.24% of free acidity, and 37.18% of ulcer index. For famotidine, the standard reduced the volume of gastric juice up to 82.24%, as well as total acidity (70.20%), free acidity (76.26%) and ulcer index (73.34%). The comparison between extract and standard showed that Acalypha indica plant extract has anti-ulcerogenic properties since the different value is small. Major secondary metabolites in the extract such as the alkaloid and steroid provide basic information for anti-ulcer activity. (Kalimuthu et al, 2010).

Anti-venom activity

Shirwaikar et al., 2004 found that the anti-venom derived from Acalypha indica can treat with Daboia russelli venom. By studying the venom-induced lethality, hemorrhage, necrotizing and mast cell degranulation in rats, it was found that 500 mg/kg of methanolic extract increased the survival rate up to 100% higher than the anti-venom itself. Later Rajendran et al,2010 studied other extracts from benzene, petroleum ether, chloroform, and acetone against similar snake venoms. The results showed that 100 mg/kg increased the survival rate of Swiss albino rats. The more polar phytochemical compounds extracted, the higher the survival rate. Meanwhile, benzene, petroleum ether, acetone and chloroform increased the survival rate at 35%, 47%, 47% and 77%, respectively. The antioxidant activity of the different extracts of Acalypha indica is one of the mechanisms of venom inactivation and inhibition. (Alam et al, 1998) The Daboia ruselli snake is found in Asian countries especially in India, Sri Lanka, Bangladesh, Myanmar and Nepal. (McDiarmid et al,1999)

Anti-viral activity

A study was conducted by Ali et al, 1996 to find the growth inhibition activity of a virus from indigenous plant medicines. Acalypha indica methanolic extracts was tested against two types of virus that is Herpes simplex virus, Type and Vesicular stomatitis virus on the HeLa cells. They used Minimum Inhibitory Concentration (MIC) to identify he anti-viral growth inhibition activity. From the results, HSV-1 virus was not affected by the Acalypha indica methanol extract, similarly VSV virus was inhibited by methanolic extract with a CD50 value of 0.05 mg/ml. Since Vesicular stomatitis virus is RNA-type virus, they stated the anti-Vesicular stomatitis virus and cytotoxic activities of extract may involve in the mode of action presumably through protein interaction. (Ali et al, 1996) Further studies is required with different virus species to gather more information related to Acalypha indica plant that can act as an anti-viral agent.

Wound healing activity

Reddy et al, 2002 confirmed that Acalypha indica has wound healing property as well as Plumbago zeylanica and Heliotropium indicum in their study. The methanolic extract from this plant was experimented on in the Albino Wistar rats by using incision and excision wound models. The 20% w/v concentration of methanolic extract was prepared in a saline for topical application. The ethanolic extract of Acalypha indica required 24 days to completely heal a wound and has the lowest breaking strength from incision wound. The extract exhibited a 34.37% healing rate on the excision wound model and 35.93% on restored incision wound. In their discussion section, they also mentioned the healing mechanism of Acalypha indica plant extract which has fair wound healing properties and poor tensile strength, thus lowering the maturation rate of collagen.(Reddy et al, 2002) The other experiments are related to wound healing activity were also carried out by Ibrahim et al, 2016. The plant extract from the mixed solvent (50% water: 50% methanol) was tested on excision and incision wounds on the Swiss albino mice (Ganeshkumar et al, 2012). Naik et al,2019 also used a mixed solvent (70% water: 30% methanol) for extraction at the plant aerial part. The 0.5 mg/ml concentration of ethanolic extract heals scratches 20% faster than the negative control. The methanolic extract has significant wound healing potential by up regulating the genes of TNF-α (Tumour Necrosis Factor - α) and TNF-β (Tumour Necrosis Factor - β) this two cytokines play a very important role in wound healing.

Anti-ageing activity

Jauharatul Husniyahis et.al confirmed to know physical characteristic of microemulsion of A. Indica leaf extract and to know antibacterial activity against Staphylococcus aureus bacteria. The microemulsions in this study used isopropyl myristate as the oil phase, tween 80 and span 80 as surfactant, isopropanol as co-surfactant and free water from CO 2. Microemulsion was made by varying the concentration of the extract into 3 formulas, there are 5%, 10% and 15%. A. indica extract obtained using ultrasonic maceration extraction method with 70% ethanol solvent. All the formulas were evaluated for the characteristics of the preparations and the antibacterial activity test against Staphylococcus aureus bacteria with the sumuran diffusion method. The research results showed that the microemulsion of A. indica leaf extract has good physical characteristic with pH value between 4.9-5.8, deep oil type, that particle size F1 9.34 µm, F2 14.22 µm and F3 9.68 µm and stable physically at 25°± 2°C and 40°± 2°C. The result of antibacterial activity test showed that F1 did not differ significantly with positive control. However, the inhibitory power of F1 is still under positive clindamycin

control of 12.98 mm and 15.05 mm. So, it can be collected that F1 is an ideal formula which has good physical characteristics and has optimum drug power. (Jauharatul Husniyah, 2018).

Poisoning effects

Acalypha indica has been used in poisoning cases and are known to possess significant antioxidant activities. The objective of this study is to evaluate the protective effects of an aqueous extract (5 g/l) of A. indica (leaves and stems), on biochemical disorder, oxidative stress and histopathological changes induced by muscle extract of puffer fish Lago Cephalus lunaris in swiss albino mice. Mice injected with L. lunaris muscle extract (1 ml/100g body weight) for 10 days showed a reduced appetite and diarrhea resulting in a lower growth rate than controls, an increase in serum Alanine aminotransferase, Aspartate aminotransferase, Alkaline phosphatase and Total & Direct bilirubin levels suggesting liver functional disorders, an increase of serum creatinine and uric acid concentrations highlighting renal insufficiency and increase in the level of serum triglycerides, total cholesterol, glucose and low density lipoproteins indicate the interference in the metabolism or biosynthesis of lipids an oxidative stress as evidenced by the raise of TBARS and the inhibition of antioxidant enzymes (Superoxide dismutase, Catalase and Glutathione peroxidase) activities in liver, kidney and heart tissues histopathological changes in liver, kidney and heart tissues. Absorption of A. indica aqueous extract as a drink, for 10 days demonstrated ameliorative action and prevented the disorders induced by L. lunaris muscle extract. (Niharika et al, 2013).

Psoriasis

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. (Rajkiran et al, 2017).

Dyeing

Saravanan et al carried out to revive the old art of dyeing with natural dye from leaves of Acalypha indica Linn. It belongs to family Euphorbiaceae, commonly known kuppaimeni. The dye has good scope in the commercial dyeing of silk in garments industry. In the present study, degummed silk fabrics were dyed with chemical and natural mordants. Dyeing was carried out by pre-mordanting, post mordanting and simultaneous mordanting. The dyed samples have shown good washing, light, rubbing fastness and perspiration fastness properties. The various color changes were measured by computer color matching software. ICPMS studies have proved that, heavy metals such as antimony, arsenic, cadmium and lead were not present in the dye extract. Anti-bacterial and anti-fungal activities of the dye were also studied. (Saravanan et al, 2013)

Anti-hemolytic activity

The current study was to assess Acalypha indica methanolic leaf extract for its antihemolytic activity, anti-bacterial activity and its various phytochemical constituents. The methanolic leaf extract of Acalypha indica shown to have reasonable anti hemolytic activity. The methanolic extract showed antihemolytic activity in the range from 27% to 54%. At varying concentration of plant extracts 20, 40, 60, 80 and 100 mg /ml the percent of inhibition of hemolysis recorded were 27%, 34%, 40%, 47%, 54% respectively. The methanolic leaf extract of Acalypha indica showed significant inhibitory effect on all of the five bacterial species such as Pseudomonas aeruginosa, Staphylococcus aureus, Escherichia coli, Bacillus subtilis and Streptococcus mutants. The inhibition zones for S. aureus were 14 mm, 16 mm and 20 mm (including well 4 mm) at concentrations of 15 µl, 20 µl and 25 µl respectively. The inhibition zones P. aeruginosa were 14 mm, 14 mm and 16 mm, 10 mm, 11 mm and 20 mm for Streptococcus mutants. The zones for E. coli were 10 mm, 12 mm and 21 mm and 14 mm, 16 mm and 19 mm for Bacillus subtilis. The phytochemical investigation of methanolic extract of Acalypha indica leaves showed the presence of carbohydrates, flavonoids, alkaloids, phenols and saponins. (Venkata et al, 2016).

Regeneration

An in vitro regeneration protocol for Acalypha indica was developed using nodal explants on MS medium augmented with different concentrations and combinations of plant growth regulators for direct and indirect regeneration. The highest frequency (63.2%) of multiple shoot regeneration with maximum number of shoots (4.1shoots per explants) was noticed on

½ strength MS medium supplemented with BAP (1.0 mg/L) in combination with KIN (0.5 mg/L). Highest percentage of callus induction (81.5%) from nodal segments was observed on ½ strength MS medium supplemented with 2, 4-D (1.5 mg/L). The in vitro derived calli were sub-cultured for shoot regeneration. ½ strength MS medium fortified with BAP (1.0 mg/L) in combination with NAA (0.5 mg/L) showed the highest percentage (62.8%) shoot proliferation from the nodal segments derived calli. Elongated shoots were rooted best on ½ strength MS medium containing IBA (1.0 mg/L) producing maximum number of roots with 70% response. The plantlets were gradually acclimatized and successfully transferred to field condition with 100% survival rate within 6 weeks after rooting. The standardized protocol reported in this study may help in large scale propagation of this plant species which is currently exploited from the nature. (Divya et al, 2014).

Kannan et.al has carried out the synthesis of Yttrium oxide (Y_2O_3) nanoparticles was carried out from Acalypha indica leaf extract. The synthesized nanoparticles were characterized by using X-ray diffraction, scanning electron microscope, energy-dispersive X-ray spectrometer and transmission electron microscope for structural confirmation. The studies clearly indicate that the synthesized (Y_2O_3) nanoparticle is a crystalline material with a particle size from 23 to 66 nm. Further analysis was carried out by Fourier transform infrared spectroscopy, to provide the evidence for the presence of Y–O–Y and O–Y–O stretching in the synthesized (Y_2O_3) nanoparticles. Thermogravimetric and differential scanning calorimetry analyses gave the thermal stability of (Y_2O_3) nanoparticles. The results of the antibacterial studies conducted by using the synthesized (Y_2O_3) revealed an increasing rate of antibacterial behavior with pathogens. (Kannan et al, 2015).

CONCLUSION

This review updates the information of Acalypha indica studies from several aspects such as phytochemical content, ethno-medicinal practice and pharmacological activities, from entire regions. The consumption of Acalypha indica as an ethnomedicinal herb has been discussed and identified with relevant pharmacological studies and phytochemical contents. The plant is applicable for treatment depending on the therapeutic activities. The preferred part of the plant for ethnomedicinal practice is its leaves and the root. Studies have identified various pharmacological activities with some positive results. The most potential therapeutic treatments are as anti-cancer, anti-inflammatory, anthelmintic, antibacterial, anti-diabetes, anti- hyperlipidemic, anti-hemolytic, anti-obesity, anti-venom and wound healing properties.

The present review shows the pharmacological study of the Acalypha indica and various phytochemical compounds responsible for it which have been reported. The whole plant of Acalypha indica have been used in conventional medicine and traditional medicine for decades and the studies done yet have authentified the medical practices. However, more clinical and pathological studies is needed to be conducted to investigate the unexploited potential of the plant.

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REFERENCES

1. Kirtikar KRB, Baman D. Indian medicinal plants. Indian Medicinal Plants. Saha R, Ahmed A, 2011b. Phytochemical constituents and pharmacological activities of Acalypha Indica Linn: A review. International Journal of Pharmaceutical Sciences Research, 1918; 2: 1900-1904.
2. Chopra R, Nayar SI, IC C. Glossary of Indian Medical Plants, New Delhi, India, 1956.
3. Finar LL. Organic Chemistry Longman, Green and Grosvent Street, London, WI, 1962; II.
4. Bauer AW, Kirby WMN, Sherris JC, Turek M. Antibiotic susceptibility testing by Standardized Single disc Method. Am J Clin Pathol, 1966; 45(4): 493-6.
5. Fanswarth NF. Biological and Phytochemical Screening of Plants. J Pharm. Sci, 1966; 55-225-276.
6. Crunkhorn P, Meacock S. Mediators of the inflammation induced in the rat paw by carrageenin. Br. J. Pharmacol, 1971; 42: 392-402.
7. Agarwal KC. Antibiotic Sensitivity Test by disc diffusion Method Standardization and Interpretation Indian. J Pathol Bact, 1974; 17: 149-159.
8. Zaikall. Spices and herbs: their antimicrobial activity and its determination. J Food Safety, 1975; 9: 97-118.
9. Harborne JB, Mabry JM, Mabry H. The Flavonoides Chapman and Hall, 1979.

10. Jain SK. Observation on Ethnobotany of the Tribals of Central Indian, Glimes of India, Ethnobotany. Oxford and SBH Publishers New Delhi, 1981.
11. Caius JE. The Medical and Poisonous Plants of India. Scientific Publishers, Jodhpur, 1986; 264-313.
12. Jain SK. A Manual of Ethnobotany Scientific Publishers, Jodhpur, 1987.
13. Bourdy G, Walter A Maternity and medicinal plants in Vanuatu. I. The cycle of reproduction. J Ethnopharmacol, 1992; 37: 179-196.
14. Burkill HM. The useful plants of west tropical Africa. Volume 2: Families EI. Botanic Gardens, 1994.
15. Martin GJ. Ethnobotany-A people and plants conservation manual. Parthenon Publishing Group Casterton Hall, Carnforth Lancashire, England, 1995.
16. Ali AM, Mackeen MM, El-Sharkawy SH, Abdul Hamid J, Ismail NH, Ahmad F, Lajis MN. Antiviral and cytotoxic activities of some plants used in Malaysian indigenous medicine. Pertanika Journal of Tropical Agricultural Science, 1996; 19: 129-136.
17. Jain SK. Medicinal Plants Pub. National Book Trust India, New Delhi, 1996.
18. Rao R. Traditional knowledge and sustainable development: Key role of ethnobiologists. Ethnobotany, 1996; 8: 14-24.
19. Alam MI, Gomes A. Viper venom-induced inflammation and inhibition of free radical formation by pure compound (2-hydroxy-4-methoxy benzoic acid) isolated and purified from anantamul (Hemidesmus indicus R. BR) root extract. Toxicon, 1998; 36: 207-215.
20. Kaushik P, Dhiman AK. Medicinal plants and Raw Drugs of India. Bishan Singh Mahendra Pal Singh, Dehradun, 1999.
21. Drug Today. Ready Reckonar of Current Medical Formulations. Nicholas Piramal (India) Limited, Mumbai, 1999; 84-85: 367-376.
22. McDiarmid RW, Campbell JA, Touré T. Snake species of the world: A taxonomic and geographic reference, 1999; 1.
23. Kokate C.K., A.P. Purohit & B.B. Gokhale, (2000). Pharmacognosy, Eights Edition Nirali Prakashan, 1999.
24. Junior A, Zanil C. Biological screening of Brazilian meditational plants. Braz. J. Sci, 2000; 367-373.
25. Reddy JS, Rao PR, Reddy MS. Wound healing effects of Heliotropium indicum, Plumbago zeylanicum and Acalypha indica in rats. J. Ethnopharmacol, 2002; 79: 249-251.

26. Shirwaikar A, Rajendran K, Bodla R, Kumar CD. Neutralization potential of Viper Russelli (Russell's viper) venom by ethanol leaf extract of Acalypha indica. J. Ethnopharmacol, 2004; 94: 267-273.
27. Savithramma N, Sulochana C, Rao K. Ethnobotanical survey of plants used to treat asthma in Andhra Pradesh, India. J. Ethnopharmacol, 2007; 113: 54-61.
28. Duraipandiyan V, Ignacimuthu S. Antibacterial and antifungal activity of Cassia fistula L.: an ethnomedicinal plant. J Ethnopharmacol, 2007; 112: 590-594.
29. Marwah RG, Fatope MO, Al Mahrooqi R, Varma GB, Al Abadi H, Al-Burtamani SKS. Antioxidant capacity of some edible and wound healing plants in Oman. Food Chem, 2007; 101: 465-470.
30. Vogel H. Drug discovery and evaluation: Pharmacological assays. Springer Science & Business Media, 2007.
31. Hnatyszyn O, Juárez S, Ouviña A, Martino V, Zacchino S, Ferraro G. Phytochemical analysis and antifungal evaluation of Sebastiania commersoniana extracts. Pharm. Biol, 2007; 45: 404-406.
32. Schmelzer, G.H. & Gurib-Fakim, A. Plant Resources of Tropical Africa 11(1). Medicinal plants 1. PROTA Foundation, Wageningen, Netherlands, 2008.
33. Perumal samy R, Ignacimuthu S, Patricraja D. Pre-liminary screening of ethnomedicinal plants from India. Eur Rev Med Pharmacol Sci, 2008; 12: 1-7.
34. Chengaiah B, Kumar MK, Alagusundaram M, Sashikala C, Chetty MC. In vitro anthelmintic activity of roots of Acalypha indica Linn. International Journal of Pharm Tech Research, 2009; 1: 1499-1502.
35. Hungeling M, Lechtenberg M, Fronczek FR, Nahrstedt A. Cyanogenic and noncyanogenic pyridoneglucosides from Acalypha indica (Euphorbiaceae). Phytochemistry, 2009; 70: 270-277.
36. Nandhakumar M, Tamil Iniyan G, Senthilkumar M, Dineshkumar B, Mitra A. In vitro assay of alpha amylase inhibitory activity of Indian medicinal herb Acalypha indica. J. Clin. Diagn. Res, 2009; 3: 1475-1478.
37. Joy B, Mathew M, Awaad A, Govil J, Singh V. Anti-oxidant studies and chemical investigation of ethanol extract of Acalypha indica Linn. Drug Plants, 2010; 1: 261-279.
38. Dineshkumar B, Vigneshkumar P, Bhuvaneshwaran S, Analava M. Phytopharmacology of Acalypha indica: A review. International Journal of BioSciences, Alternative and Holistic Medicine (IJBSAHM), 2010; 1: 27-32.

39. Kalimuthu S, Rajesh P, Kannan VR, Balamurugan B, Chandrasekar T. Antiulcer activity of methanolic extract of Acalypha indica Linn. (Euphorbiaceae) by pylorousligture and swim stress induced ulceration. Journal of Pharmacy Research, 2010; 3: 2779-2783.
40. Rahman MA, Bachar SC, Rahmatullah M. Analgesic and anti-inflammatory activity of methanolic extract of Acalypha indica Linn. Pak. J. Pharm. Sci, 2010; 23: 256-258.
41. Rajendran K, Shirwaikar A, Mehta M, Bharathi RV. In vitro and in vivo anti-snake venom (Daboia russelli) studies on various leaf extracts of Acalypha indica Linn. International Journal of Phytomedicine, 2010; 2.
42. Jayakumari, M., et. al., Antibacterial potential of Acalypha indica against human, International Journal of Current Research, 2010.
43. Takle V, Savad R, Kandalkar A, Akarte A, Patel A. Pharmacognostic and phyto-chemical investigations of aerial parts of Acalypha indica Linn. Pharmacognosy Journal, 2011; 3: 33-35.
44. Ranju G, Niranjan S, Kumar PS, Kumar PV, Kumar PS. In vitro anthelmintic activity of Acalypha indica leaves extracts. International Journal of Research in Ayurveda and Pharmacology, 2011; 2: 247-249.
45. T.Murugan, Antibacterial activity of various solvent extracts of the indian herbal plant acalypha indica against human pathogens causing nosocomial infection, International Journal of Pharmaceutical & Biological Archive, 2011; 2(5).
46. Sakthi SS, Geetha M, Saranraj P.Pharmacological screening of Datura metel and Acalypha indica for its antifungal activity against pathogenic fungi. International Journal of Pharmaceutical Science and Health Care, 2011; 2: 15-30.
47. Schmelzer, G.H.; A. Gurib-Fakim "Acalypha indica L." ([Internet] Record from Protabase). PROTA (Plant Resources of Tropical Africa / Resources vegetables de l'Afrique tropicale). Wageningen, Netherlands: Prota Foundation. Retrieved, 2011; 29.
48. Sanseera D, Niwatananun W, Liawruangrath B, Liawruangrath S,Baramee A, Trisuwan K, Pyne SG. Antioxidant and anticancer activities from aerial parts of Acalypha indica Linn. Chiang Mai University Journal of Natural Sciences, 2012; 11(2): 157- 168.
49. S.Chandra Mohan , S.Dinakar , T.Anand , R.Elayaraja, B.SathiyaPriya, Phytochemical, GC-MS analysis and Antibacterial activity of a Medicinal Plant Acalypha indica, IJPRIF, 2012; 4(3): 1050-1054.
50. Ganeshkumar M, Ponrasu T, Krithika R, Iyappan K, Gayathri VS, Suguna L. Topical application of Acalypha indica accelerates rat cutaneous wound healing by up-regulating the expression of type I and III collagen. J. Ethnopharmacol, 2012; 14: 214-22.

51. D. Sanseera and W. Niwatananun and B. Liawruangrath and S. Liawruangrath and Aphiwat Baramee and Kongkiat Trisuwan and S. Pyne., Antioxidant and anticancer activities from aerial parts of Acalypha indica Linn, 2012. Available from: https://www.semanticscholar.org/paper/Antioxidant-and-anticancer-activities-from-aerial-Sanseera-Niwatananun/cb8f1d073771605f69249dd1f24a46944d91cd47
52. Rajasekaran S, Anandan R, Nishad K. Antihyperlipidemic activity of Acalypha indica Linn. onatherogenic diet induced hyperlipidemia. Int. Jour of Pharm. & Pharm. Sci, 2013; 5: 699-701.
53. Moon J, Do H-J, Kim OY, Shin M-J.Antiobesity effects of quercetin-rich onion peel extract on the differentiation of 3T3-L1 preadipocytes and the adipogenesis in high fat-fed rats. Food Chem. Toxicol, 2013; 58: 347-354.
54. Anirban mullick, et. al., In-vitro assay of antioxidant and antibacterial activity of leaf extract and leaf derived callus extract of acalypha indica, I13JPBS, 2013; 3(1): 504-510.
55. Niharika Mandal, Samanta Sekhar Khora "Ameliorative action of aqueous extract of Acalypha indica against puffer fish Lagocephalus lunaris induced toxicity" Int. J. Drug Dev. & Res., April-June, 2013; 5(2): 257-271.
56. G. Senthilmurugan @ Viji, et. al., Screening and antibacterial activity analysis of some important medicinal plants, International Journal of Innovation and Applied Studies, 2013; 2(2): 146-152.
57. P.Saravanan, G.Chandramohan , P. Shanmuga Sundaram, P. Sumathi., A study on extraction and application of eco – friendly natural dye extracted from leaves of acalypha indica linn on silk fabric., IJTFT, 2013; 3(5): 1-8.
58. Mousmi Saikia, Pratap J handique in vitro propagation of acalypha indica linn.: a medicinally important plant. IJLBPR, 2014; 3: 2.
59. Divya N, Thenmozhi S, Suresh kumar BT and Selvan M: Antibacterial Activity of Medicinal Plant against Wound Infected Pathogens. Int J Pharm Sci Res, 2014; 5(11): 4942-47.doi: 10.13040/IJPSR.0975-8232.5 (11).4942-47.
60. Junaedi, Yusmaniar ,Sujati Woro Indijah,. Comparision and Extract Hypoglycemic Activity Root Extract Tablet Cats (Acalypha Indica Linn) Mice the White Male Strain Ddy, Asian Journal of Applied Sciences, 2014; (ISSN: 2321 – 0893): 02-05.
61. Sivasankari B, Anandharaj M, Gunasekaran P. An ethnobotanical study of indigenous knowledge on medicinal plants used by the village peoples of Thoppampatti, Dindigul district, Tamilnadu, India. J. Ethnopharmacol., 2014; 153: 408-423.

62. Amarnath K, Dhanabal J, Agarwal I, Seshadry S. Cytotoxicity induction by ethanolic extract of Acalypha indica loaded casein-chitosan microparticles in human prostate cancer cell line in vitro. Biomedicine & Preventive Nutrition, 2014; 4: 445-450.
63. Vijayarekha P, Sangottaiyan N, Noorjahan A, Ambiga S. Antibacterial Activity of Acalypha indica Linn. Int. J Curr Microbiol App Sci, 2015; 4(6): 1133-1138.
64. Soruba E, Sundaram V, PathyManian R, Kulanthaivelu K, Balasundaram S. Antioxidant, antibacterial and anti-inflammatory activity of Acalypha indica and Terminalia chebula: An In-vitro analysis. Research Journal of Pharmaceutical, Biological and Chemical Sciences, 2015; 6: 180.
65. Muzammil MS, Manikandan M, Jafar A, Sakthivel P, Geetha S, Malarkodi R. Anti-inflammatory studies on Acalypha indica L. leaves by membrane stabilization. Indian Journal of Natural Products and Resources (IJNPR) [Formerly Natural Product Radiance (NPR)], 2015; 5: 195-197.
66. Ruslan NF. Evaluation of Acalypha indica extracts for antioxidant and antibacterial activities. Department of Biosciences and Health Sciences. Universiti Teknologi Malaysia, 2015.
67. Naga Lakshmi M, Pavithra S, Ponmozhi V, Jaganathan J, Karthik L, Shree Devi M.S., Anti-bacterial activity of selected medicinal plants, Malaya Journal of Biosciences, 2015; 2(3): 153-159.
68. S K Kannan, M Sundrarajan., Biosynthesis of Yttrium oxide nanoparticles using Acalypha indica leaf extract., Bull. Mater. Sci., 2015; 38(4): 945–950.
69. Venkata Narasimha Kadali, Tadi Ramesh, Sudhakara Rao Pola, BV Sandeep, T.Divakar. Evaluation of Anti hemolytic activity, antibacterial activity and phytochemical investigation of Acalypha indica methanolic leaf extract International Journal of Botany Studies, 2016; 1(2); 14-18.
70. Scaffidi A, Algar D, Bohman B, Ghisalberti EL, Flematti G. Identification of the cat attractants isodihydronepetalactone and iso iridomyrmecin from Acalypha indica. Aust. J. Chem, 2016; 69: 169-173.
71. Chekuri S, Rao NB, Panjala S, Vankudothu N, Anupalli RR. Phytochemical analysis, anti-oxidant and anti-microbial activity of “Acalypha indica” leaf extracts in different organic solvents. International Journal of Phytomedicine, 2016; 8: 444-452. (IF:1.23)
72. Sudhakar chekuri, Narendar Vankudothu , , Shivaprasad Panjala, Nirmala Babu Rao, Roja Rani Anupalli, Phytochemical analysis,antioxidant and anti- - microbial activity of

"Acalypha indica" leaf extracts in different organic solvents, International Journal of Phytomedicine, 2016; 8: 444-452.

73. Batubara I, Wahyuni WT, Firdaus I. Utilization of Anting-Anting (Acalypha indica) leaves as antibacterial. IOP Conference Series: Earth and Environmental Science. IOP Publishing, 2016; 012038.
74. Ibrahim AM. In vitro evaluation and wound healing cream formulation of Acalypha indica Linn ethanolic extract. Department of Biosciences and Health Sciences. Universiti Teknologi Malaysia, 2016.
75. Chekuri S, Panjala S, Anupalli RR. Cytotoxic activity of Acalypha indica L. hexane extract on breast cancer cell lines (MCF-7). The International Journal of Phytopharmacology (Pharmacognosy and Phytomedicine) research, 2017; 6(5): 264-268.
76. Wang D, Zhang S, Chang Z, Kong D-X, Zuo Z. Quebrachitol: Global status and basic research. Natural Products and Bioprospecting, 2017; 1-10.
77. Rajkiran Reddy Banala, et. al., Aqueous extract of Acalypha indica leaves for the treatment of Psoriasis: In-vitro studies, International Journal of Bioassays, 2017; 6(04).
78. Jauharatul Husniyah, Rahmi Annisa, Burhan Ma'arif,. formulation and antibacterial activity test of staphylococcus aureus microemulsion of anting-anting (acalypha indica) leaf extract using isopropyl miristat as oil phase,. J. Islamic Pharm, 2018; 3(1): 1-7.
79. Aushi Nag, Dr. Anoop M., Komal Sharma, Dr. Khushbu Verma., Acalypha Indica L. an Important Medicinal Plant with Antimicrobial agents: a Review., IJRAR, 2018; 5: 4.
80. Deepesh D,Sruthy B ., Prema K.H ,Latha M.S, docking study on mycobacterium tuberculosis with phytochemicals of acalypha indica, International Journal of Current Advanced Research, 2018; 7(5)(E): 12533-12537.
81. Naik R, Nemani H, Pothani S, Pothana S, Satyavani M, Qadri SS, Srinivas M, Parim B. Obesity-alleviating capabilities of Acalypha indica, Pergularia demia and Tinospora cardifolia leaves methanolic extracts in WNIN/GR-Ob rats. Journal of Nutrition & Intermediary Metabolism, 2019; 16: 100090.
82. Pasumarthi brahmam, Kanikaram sunita, Phytochemical investigation of plants acalypha indica (l.) and cocculus hirsutus (l.) from prakasam ,district, andhra pradesh, india, Asian Journal of Advances in Medical Science, 2019; 1(1): 1-9,
83. Morphology of Flowering Plants, Higher Biology, Dulal Chandra Santra.
84. Dr.J.Raamachandran, HERBS OF SIDDHA MEDICINES-The First 3D book on HERBS.
85. Ruslan, Nur Fathin, Evaluation of Acalypha indica extracts for antioxidant and antibacterial activities, Universiti Teknologi Malaysia Institutional Repository.

86. Sudhakar Chekuri, Lali Lingfa, Shivaprasad Panjala, K. C. Sai Bindu,Roja Rani Anupalli, Acalypha indica L. - an Important Medicinal Plant: A Brief Review of Its Pharmacological Properties and Restorative Potential, European Journal of Medicinal Plants, 2020; 31(11): 1-10, Article no.EJMP.58589.
87. Globinmed, Malaysian Herbal Monograph, Available from: https://www.globinmed.com/index.php?option=com_content&view=article&id=106553:acalypha-indica-l&catid=209&Itemid=143