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RESEARCH ARTICLE

A REVIEW ON *ACALYPHA WILKESIANA* MUELL. ARG.

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ABSTRACT

Acalypha wilkesiana Muell. Arg. commonly known as Irish petticoat belongs to the family Euphorbiaceae. It is widely used in Nigeria as a traditional medicine to cure various diseases. Various phytochemical compounds such as saponins, tannins, alkaloids, phlobatanins, phenolics, cardiac glycosides, sesquiterpenes, monoterpenes, triterpenoids, polyphenols, gallic acid, corilagin, geraniin, quercetin 3-O-rutinoside, kaempferol 3-O-rutinoside and anthroquinone have been reported. Due tothe presence of these phytoconstituents the plant has been reported to possess antibacterial, antifungal, anti-oxidant, anti-obesity, anti-diabetic, anti-hypertensive, anti-cholesterol and anti-arrhythmic, anti-malarial, hypnotic and anticonvulsant, antiemetic, anti-cancerous, anti-parasitic and analgesic activity, diuretic and anti HIV activity and hepato protective activity. The present paper explores the medicinal uses, phytochemical and pharmacological effects of *Acalypha wilkesiana* Muell. Arg. and tried to compile information that may help researchers for further investigation.

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INTRODUCTION

Plants are reservoirs of different phytochemical compounds and enzymes. These compounds can be alkaloids, tannins, volatile oils, flavonoids, saponins, tannins, phenolics, glycosides, etc. which have been assessed for their anti-oxidant, anti-mutagenic, anti-carcinogenic and other biological effects (Patil *et al.,* 2009; Krishnaswamy and Raghuramulu, 1998). Twenty-five percent of people in the world depend on traditional medicinal plants as drugs for curing various diseases and ailments (Reddy, 2004; Kumara *et al.,* 2011; Sharma and Painuli, 2011). Over 6000 plants in India are used in traditional, folk and herbal medicine representing about 75% of the medicinal needs of the developing countries (Rajshekharan, 2002). There are always side effects associated with synthetic drugs. Researchers arediverting their attention to the folk medicines which are safe and effective and are the oldest health care products (Mukherjee, 2002). Interestingly, natural product research guided by ethno-pharmacological knowledge has made substantial contributions to drug innovation by providing novel chemical structures or mechanisms of action (De Smet, 1997). Pharmaceutical industries use traditional medicines as a source of bioactive agents that can be used in the preparation of medicines. Most medicinal plants are being formulated into pharmaceutical dosage forms like tablets, creams, ointments, syrups, and lotions.

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Taxonomy

Kingdom - Plantae; Division –Spermatophyta;
Class – Monochlamydae; Series-Unisexuales
Family - Euphorbiaceae; Genus – *Acalypha*
Species – *wilkesiana*
Botanical name: *Acalypha wilkesiana* Muell. Arg.

Vernacular Names

English: Irish Petticoat; Sanskrit: Svetakhadira

Common Names

Acalypha wilkesiana Muell. Arg., is commonly called as Irish petticoat. Other common names include: copperleaf Jecob's coat, Fijian Fire Plant, Fire Dragon Plant, Beefsteak Plant, Hudling, Redleaf, Josephs Coat, Hojade Cobre Huu-Krataai, and Match-Me-If-You-Can (Christman, 2004). The Hausas of the Northern Nigeria call it "Jiwene", while the Yoruba of the Southern Nigeria call it "awor-oso". In Malaysia, locally it is called "*Akalifa*" (Ong 2006).

Description

The plant was named after Admiral Charles Wilkes, a 19th century American naval officer and explorer in the South Pacific (Wiart, 2006). The name *Acalypha wilkesiana* originated from Greek, *a,* which means "without" and *kalyphos,* which means "cover". *Acalypha wilkesiana*,

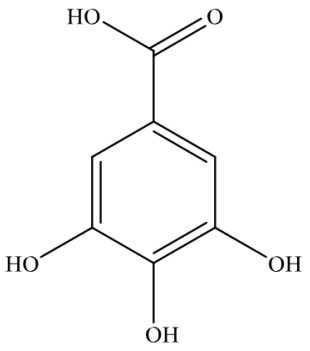
belonging to family Euphorbiaceae, (Spurge family) is an evergreen shrub believed to be originally native to Fiji and South Pacific Islands. The plant is well distributed throughout tropical Africa, South Africa, India, Sri Lanka, America, Yemen, Pakistan southern and central parts of Florida. It grows 3 meters (9. 8 ft) high and spreads 2 metres (6 ft 7 in) across. The stem is erect with many fine hairy branches. It has a closely arranged crown. The leaves are coppery green with red splashes of colour giving a mottled appearance. The leaves are large and broad with teeth around the edge. They can be 10–20 centimeters (3. 9–7. 9 in) long and 15 centimeters (5 - 9 in) wide heart-shaped alternate, elliptic to oval, serrate, hairy with combination of colours like green, purple, yellow, orange, pink or white depending on cultivation. They can be flat or crinkled. The flowers are reddish in spikes at the end of branches. They have separate male and female flowers on the catkin-like racemes beneath the foliage on the same plant. The male flowers are in long spikes which hang downwards while the female flowers are in short spikes. The flowers are apetalous and without nectar disc. Its flowering season is between February to December (Sagun *et al.,* 2010). It is planted around homes for horticultural purposes. It looks its best when provided with regular watering during drought and grows on a wide variety of garden soils, at a minimum temperature above 10 °C. It is easily propagated by air layering or stem cutting at any time of the year (Edward, 2011). Many cultivars with different leaf shapes, sizes and colors have been developed and grow best in fertile, well-drained soil (Riley, 1963). *A. wilkesiana* 'Godseffiana' has narrow, drooping, green leaves with creamy-white margins, 'Marginata' has coppery-green leaves with pink or crimson margins, 'Macrophylla' has larger leaves, variegated with bronze, cream, yellow and red, while 'Musaica' has green leaves that are mottled with orange and red (Gilman, 1999; Christman, 2004).

Traditional uses

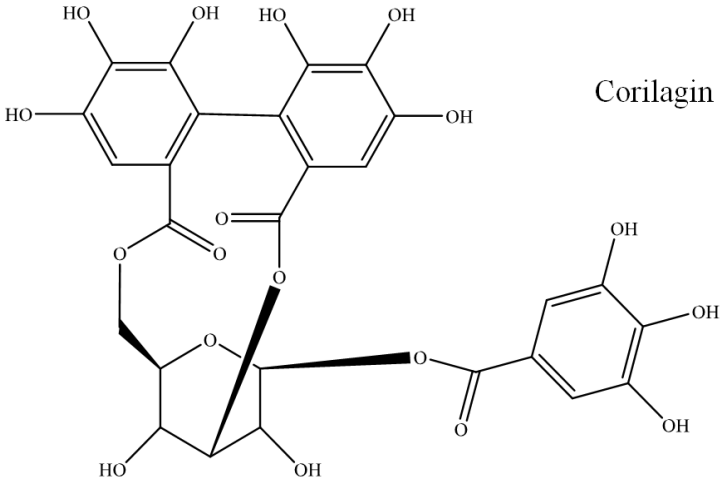
Euphorbiaceae is one of the largest group of flowering plants with 300 genera and 7500 species which provides numerous plants used for treatment of inflammatory conditions, wounds and bacterial infections (Wiart 2006). *Acalypha wilkesiana* Muell. Arg. one of the member belonging to this family is reported to be highly medicinal. The leaves of *Acalypha wilkesiana* are eaten as vegetables in the management of hypertension (Ikewuchi *et al.,* 2008). The plant is popularly used for the treatment of malaria, dermatological and gastrointestinal disorders (Akinde and Odeyemi, 1987). Local communities in Ado town in Ekiti State and Ilorin city in Kwara State of Nigeria use leaves of *A. wilkesiana* as herbal remedy for the undefined skin infection in neonates and children of a year old (Aladeand Irobi, 1993). The leaf is boiled in water to yield a dark red liquid which is added to bathing water. A portion of the boiled liquid is also given to the baby to drink. Aqueous leaf extract of *A. wilkesiana* is traditionally used to treat neonatal jaundice in western part of Nigeria on short-term basis. It had hyponatremic properties with no adverse effect on the liver. It has been used to treat antifungal and antibacterial ailment especially in the western part of Nigeria. According to Ogundaini (2005) and Oliver (1959), the expressed juice or boiled decoction is used for the treatment of gastrointestinal disorders and fungal skin infections such as *Pityriasis versicolar, Impetigo contagiosa, Candida intetrigo, Tinea versicolor, Tinea corporis and Tinea pedis.* The aqueous extract is also used in the management of fever in infants as well as abnormal sodium and potassium metabolism that accompanies hypertensions. The leaf-poultice is used in the treatment of headache, swellings, cold and malaria (Akinyemi *et al.,* 2005). The seeds of *A. wilkesiana* are used in compounding a complex plant mixture used by traditional healers in South-West Nigeria to treat malaria, breast tumors and inflammation (Oyelami *et al.,* 2003; Akinyemi *et al.,* 2005; Bussing *et al.,* 1999; Taraphdar *et al.,* 2001). In West Africa, it is used for the treatment of headache and cold and in Nigeria; the cold extract of the leaves is used to bath babies with skin infection (Adesina *et al.,* 2000). Oyelami *et al.,* (2003) carried out a non-comparative study to evaluate the safety and efficiency of *Acalypha wilkesiana* ointment using 32 Nigerians with mycological as well as clinical evidence of mycoses. The ointment successfully controlled the mycoses in 73. 3% of the affected patients. Previous scientific evaluation of *Acalypha wilkesiana* leaves revealed antimicrobial and antifungal activity (Oyelami *et al*, 2003; Adesina *et al.,* 1980; 2000; Oladunmoye, 2006; Erute and Oyibo, 2008). According to Ong (2006), the leaves are traditionally used in Malaysia for treatments of inflammation, headache, fever and flu, whereas its roots are boiled to wash haemorrhoids. A beverage consisting of about 60 g of the leaves boiled in goat's milk was used to lower blood temperature, treat fever, relieve cough and heal pimples. 10 g of the leaves boiled with sugar can be used to treat thrombocytopenic purpura and allergic purpura which are skin disorders caused by bleeding underneath the skin (Wiart 2006). In West Africa, the plant is used in the form of decoction, infusion or tincture. The leaves are rubbed in between palms and the juice is smeared on the affected part of a patient for treatment of *Pityriasis versicolor* and other skin infections. Ground leaves may be used as soap to wash affected parts of the skin (Adesina *et al.,* 1980). The whole plant is useful in treating chronic bronchitis, asthma, scabies and other skin diseases, rheumatism, congestive headache (Itankar *et al.,* 2011). According to Neuwinger (2000) and Lim *et al.,* (2013), the leaves of *Acalypha wilkesiana* are used to treat fungal skin diseases and infections, *Pityriasis vesicolor*, superficial mycoses. Also used against methicillin resistant bacteria, to combat constipation, nasopharyngeal infections, pain-killers, applied externally as an antiseptic to ulcers and wounds, anti-diarrhoeal agent, used as antibiotic, bacteriostatic and fungistatic. The plant possesses anticancer, antibacterial, antifungal, antidiabetic, analgesic, antiparasitic and antihypertensive properties.

Phytochemistry

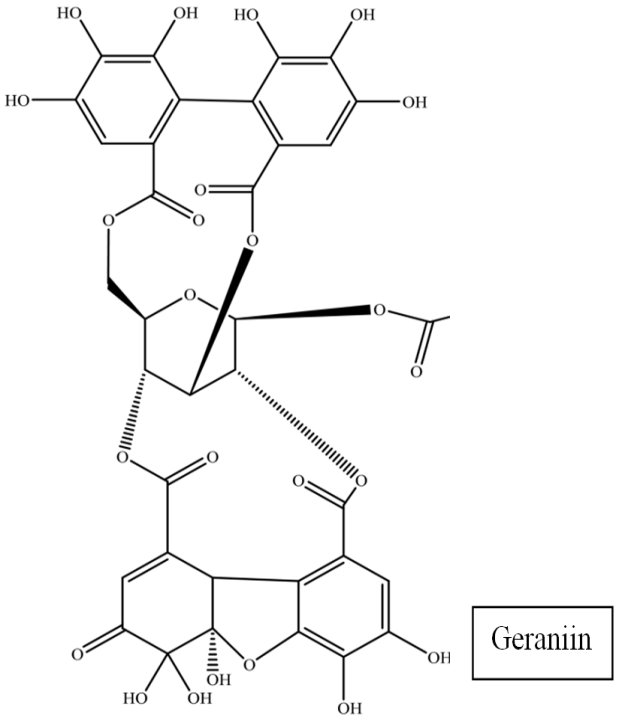
The phytochemical screening of the leaf extract revealed the presence of saponins, tannins, alkaloids, phlobatanins, phenolics and cardiac glycosides (Awe and Eme, 2014; Oladunmoye, 2006; Soladoye *et al.,* 2008; Akinyemi *et al.,* 2005). Earlier analysis of the leaves of *Acalypha wilkesiana* revealed the presence of sesquiterpenes, monoterpenes, triterpenoids, polyphenols, gallic acid, corilagin, geraniin, quercetin 3-O-rutinoside, kaempferol 3-O-rutinoside, saponins, tannins, anthroquinone and glycosides (Akinde, 1986; Adesina *et al.,* 2000). They were also found to be rich in some potent hepatoprotective agents like vitamin C (Ikewuchi and Ikewuchi, 2009), flavonoids and tannic acid (Ikewuchi *et al.,* 2010, 2011). Igwe *et al.,* (2016) based on studies on ethanol extract phytocomponents by GCMS Analysis, revealed the presence of 12 compounds.



Galic acid

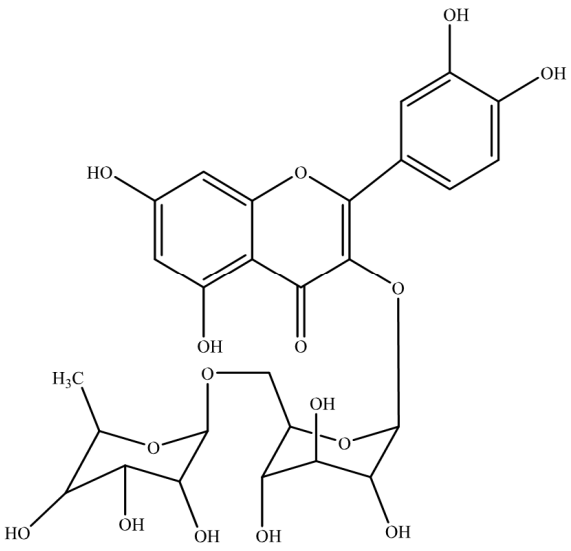


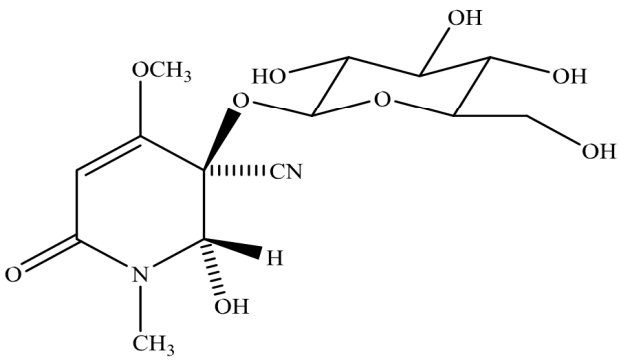
Corilagin



Geraniin

(c)





Kaempherol-3-O-rutinosideQuercetin-3-O-rutinoside

Among the 12 compounds, the most abundant were 2-ethyl-1-hexene (C_8H_{16}); n-hexadecanoic acid or plamitic acid ($C_{16}H_{32}O_2$) and Butane 1,4-diol ($C_4H_{10}O_2$) which demonstrated various medicinal potentials. Other compounds were 3-methylene-1-vingl-1-cyclopentene, 2-vinylbicyclo hex-2-ene, acetophenone, 1,4-dimethyl benzene, styryl alcohol, 3-methyl-6-hepten-1-ol. Madziga *et al.* (2010) and Kingsley *et al.* (2013) reported the presence of high quantity of carbohydrates, tannins and flavonoids, medium quantity of phlobatanins, cardiac glycosides, saponins, alkaloids and minute quantity of terpenes and steroids in the aqueous extract of leaves of *A. wilkesiana*. They also reported a very high concentration of chloride, sodium and potassium ions. Calcium, iron, magnesium and zinc were in medium concentration while copper and manganese were in minute concentration. Basil *et al.,* (2007); Kingsley *et al.,* (2013) and Aladejimokun *et al.* (2017) reported the presence of alkaloids, carotenoids, flavonoids, proteins, lipid, carbohydrate, reducing sugar, fibre, saponins and tannins, all of which have potential health promoting effects.

Pharmacological activities

Anti-microbial and antifungal activity

Apart from its use as a vegetable, *Acalypha wilkesiana* has been reported to have antimicrobial and antifungal properties (Akinde, 1986; Alade and Irobi, 1993; Adesina *et al.,* 2000; Ogundaini, 2005; Oladunmoye, 2006; Musa *et al.,* 2000). Awe and Eme (2014) reported that ethanolic extracts of *A. wilkesiana* exhibited antibacterial activities and inhibited the growth of gram positive (*S. aureus* and gram negative bacteria (*E. coli, K. pneumonia and Shigellasp.*). Gotep *et al.,* (2010) carried out *in vitro* antimicrobial screening using ethanol extracts of *A. wilkesiana*. They also reported that the ethanol extract of the plant had varying antimicrobial activity against *Staphylococcus aureus*, *Yersinia enterocolitica*, *Escherichia coli, Salmonella typhi*, *Pseudomonas aeruginosa* and *Klebsiella aerogenes*. Further studies on fractions of the plant extract report its inhibitory effects on the production of methicillin-resistant *Staphylococcus aureus* (Santiago *et al.,* 2015) as well as bactericidal activities (Din *et al.,* 2013). Ethanolic extract of *Acalypha wilkesiana* formulation containing the emulsifying ointment base showed superior anti-bacterial and anti candidal activity (Azubuikie *et al.,* 2013). According to Olaribigbe and Sorbari, (2014), *Acalypha wilkesiana* creams formulated with cetomacrogol have shown the greatest antimicrobial properties while the least antimicrobial properties were reflected by emulsifying ointment. This is due to the impeding effect of paraffin present in the formulation. In consequence, the leaf of *A. wilkesiana* possesses antimicrobial activity to treat skin infections as claimed by the traditionalists and can be used in formulating herbal skin creams to treat some skin infections. According to Adesina *et al.,* (2000) and Gutierrez-Lugo *et al.,* (2002), the antibacterial effect of extracts of *Acalypha wilkesiana* on gastrointestinal tract is due to triterpenoids of cycloartane-type, flavonoids like quercetin- and kaempferol-derivatives.

Anti-obesity effect

Polyphenols, one of the components of leaf extract of *Acalypha wilkesiana*, has been shown to possess a strong anti-obesity activity (Rayalam *et al.,* 2008) and inhibitory activity against pancreatic lipase, which leads to weight loss (Thielecke and Boschmann, 2009; Nakai *et al.,* 2005). These components may affect body weight by changes in body-fat metabolism and oxidation or increasing metabolic rate which seems to be a mechanism for the anti-obesity effect of leaf extract of *Acalypha wilkesiana* (Iyamu *et al*. 2014).

Anti-diabetic activity

Al-Attar (2010) conducted a physiological study on the effect of leaf extract of *Acalypha wilkesiana* on streptozotocin induced experimental diabetes in male mice and reported its anti-diabetic properties. The leaf extract supplementation was beneficial in lowering the level of blood glucose, improved the lipid and electrolytes profile in experimental diabetic mice. According to Alli Smith *et al.,* (2011), the aqueous extract of leaf causes reduction of blood glucose level in normoglycemic rats suggesting the possibility of its usage in managing diabetes or hyperglycaemia. *In vivo* studies evidenced the anti-diabetic properties from *A. wilkesiana* Muell. Arg. and *Acalypha indica* L. (Ikewuchi *et al.,* 2011; Itankar *et al.,* 2011) but the active constituents are yet unknown.

Anti-hypertensive activity

Ikewuchi *et al.,* (2008), studied the effect of *Acalypha wilkesiana* Muell. Arg. on plasma sodium and potassium concentration of normal rabbits and found that it has anti-hypertensive properties. The plant extract could also be useful in controlling rennin-dependent hypertension due to the presence of phytochemical, 2-butenyl propionate identified by GCMS analysis Igwe *et al*. (2016). According to Kingsley *et al,* (2013), the cardiotonic activities of steroids, present in high amount in the leaves, may be beneficial in the management of hypertension since it has direct effects on the contractions of the cardiac muscles.

Anti-cholesterol and anti-arrhythmic activity

The use of *A. wilkesiana* in the treatment of diabetes and cardiovascular related diseases, spurred investigation by Ikewuchi and Ikewuchi (2010) who examined the effect of the plant extract administration on blood sugar and cholesterol levels using a rat model. They reported that the aqueous extract of A. wilkesiana had a lowering effect on blood cholesterol level as well as blood sugar, thereby explaining its use in the treatment of cardiovascular related diseases. Cardiac glycosides are used therapeutically in the treatment of cardiac failure, due to their anti-arrhythmic effects. Cardiac glycosides are known to work by inhibiting Na^+/K^+ pump. This causes an increase in the level of sodium ions in the myocytes which then leads to a rise in the level of calcium ions. This inhibition increases the amount of Ca^{2+} ions available for contraction of the heart muscles which improves cardiac output and reduces distention of heart; thus are used in the treatment of congestive heart failure and cardiac arrhythmia, which is one of the major benefit associated with the use of *A. wilkesiana* leaves (Kingsley *et al.,* 2013). The presence of alkaloids in the leaves of *A. wilkesiana* indicates its use as a source of substances that are precursors of neurotransmitters. These neurotransmitters function in the transmission of signals in the nervous system, which has direct effect on the contraction of blood vessels in the cardiovascular system. The effects of these alkaloids on the cardiovascular system, helps in the management of cardiovascular diseases, hypertension and as a source of precursors for the synthesis of psychoactive drugs (Kingsley *et al,* 2013).

Anti-oxidantactivity

A. wilkesiana enhanced the antioxidant capacity of the animals and decreased reactive oxygen species mediated oxidation of lipids (Ogbuehi *et al.,* 2014). Novia *et al.,* (2016) reported that the methanolic extract of *Acalypha wilkesiana* leaves and the mixture of flowers-fruits-seeds had the highest antioxidant activity. Antioxidant and protective properties were also elicited by *A. indica* L., *A. fruticose* Forsk., and *A. racemosa* Wall. ex Baill. (Badami *et al.,* 2007; Iniaghe *et al.,* 2008; Mothana *et al.,* 2010). Igwe *et al.,* (2016) reported that ethanolic leaf extract of *Acalypha wilkesiana* contain pharmacologically useful active phytochemicals which have effect on progesterone receptors, glucocorticoid receptors, androgen and estrogen receptors with a mild antioxidant and atherosclerotic activity also could be beneficial in the management of pregnancy related cases specially to synchronize estrus. According to Kingsley *et al,* (2013), the antioxidant activity of *Acalypha wilkesiana* leaves is due to the presence of rich flavonoids, which are useful in protecting against damage by free radicals. They also show anti-allergic, anti-inflammatory, anti-microbial and anti-cancer activity, thus indicating the enormous benefits associated with *Acalypha wilkesiana* leaves.

Anti-malarial activity

Ogbuehi *et al.* (2014) investigated the protective effect of *A. wilkesiana* on malaria infected rats 70% methanol as extract suggesting safety to the liver of the rats at doses of 50 and 100 mg/kg of the extract.

Hypnotic and anticonvulsant effect

Presence of acetophenone found to possess hypnotic, tranquilizing and anticonvulsant effect. This compound could be used to induce sleep (hypnosin) or to immobilize reflex as a preanesthetic agent in treatments or surgery. It could also be used to inhibit convulsions acting as a sedative by depressing the central nervous system (Igwe *et al.,* 2016).

Hepato protective activity

Experiments with albino rats, Ikewuchi *et al.* (2011) reported that at doses of 100mg/kg and below, the plant possess hepato protective activity. Novia *et al*. (2016), reported that the high antioxidant activity had correlation with phenol and tannin, especially flavonoids contents. This study clearly demonstrates that extracts of the leaves of *Acalypha wilkesiana* are effective agents in the treatment and prevention of carbon tetrachloride-induced hepatic cytotoxicity (Ikewuchi *et al.,* 2011).

Antiemetic activity

A recent study from Quds *et al.,* (2012) showed antiemetic property of *A. ornate* Hochst. ex A. Rich., *A. wilkesiana* Müll. Arg. and *A. fimbriata* Schumach. & Thonn.

Anti-cancerous activity

Beta carotene contents in the leaves of *A. wilkesiana* act as an antioxidant, which helps to boost the immune system against cancer, cataract and damaging effects of radiation. Basil *et al.,* (2007) and Lim *et al.,* (2011 & 2013) reported that a combination of *A. wilkesiana* ethyl acetate extract and α-tocopherol has potent cytotoxic effects towards human brain and lung cancer cell lines. Extracts of *A. wilkesiana* Muell. Arg., *A. alopecuroidea* Jacq. and *A. australis* L. displayed anti-cancer properties against different cell lines *in vitro* (Madlener *et al.,* 2010; Shin *et al.,* 2012).

Anti-parasitic and analgesic activity

Udobang *et al.,* (2010) recently reported that the crude leaf extracts and fractions of this plant exhibit anti-parasitic and analgesic properties.

Diuretic and anti HIV activity

Kingsley *et al.,* (2013) mentioned the diuretic effect of the plant as well as its possible use in the management of HIV infection may be connected to its tannin content.

Conclusion

Acalypha wilkesiana Muell. Arg. has been used as traditional medicine for curing various diseases affecting people in different parts of the world. In India, however, the plant gained little attention because of its ornamental nature. More research needs to be carried out to understand and tap the medicinal potential of this plant for the future use in modern drug industries.

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