

Review

Review of beneficial and remedial aspects of *Cardiospermum halicacabum* L.

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Eco-friendly and bio-friendly plant based commodities have recently been given consideration for the avoidance and treatment of various human infections including microbial diseases throughout the world. *Cardiospermum halicacabum* L. belonging to family Sapindaceae is a herbaceous plant, extensively dispersed in tropical and subtropical areas of world. It grows in plains of Africa, America, Bangladesh, India and Pakistan. The herb is pubertal or glabrous, yearly or perpetually having a slim twig that climbs by tendrillar hooks. Leaves are ternate bicomponent and leaflets acuminate at top. The roots, leaves and seeds of herb are employed as herbal medication. The presence of flavones, aglycones, triterpenoids, glycosides, variety of fatty acids and volatile esters are confirmed by phytochemical screening. Secondary metabolites present include alkaloids, carbohydrates, proteins, saponins lignin, steroids, and cardiac glycosides. β -arachidic acid, apigenin, apigenin-7-O-glucuronide, chrysoeriol-7-O-glucuronide and 80 luteolin-7-O-glucuronide along with two crystalline compounds beta-sitosterol and beta-D-glycoside. Acetic acid, 1,6,10-Dodecatriene, 7,11,dimethyl-3- methylene-(E)-, phenol, 2,6-bis (1,1-dimethylethyl)-4-methylmethylcarbamate, 3-O-methyl-d-glucose, 1,14-Tetradecanediol, 3,7,11,15-Tetramethyl-2-hexadecen-1-ol, phytol, pseudoephedrine, 2-propenamide were also recognized in ethanolic extract. The plant possess activities like antimicrobial, antifungal, antiparasitic, antidiarrheal, anxiolytic, rubifacient, antipyretic and management of painful, arthritic inflammatory conditions. Further investigations are needed to assess its isolated mode of action on various activities.

Key words: *Cardiospermum halicacabum*, anxiolytic, antipyretic, antimicrobial, antifungal, antiparasitic, antidiarrheal, rubifacient.

INTRODUCTION

Plant-based drugs have been used globally for healing different illnesses in conventional systems of medicines. Around 80% of world's population still depends on medicinal plants for their primary health care needs especially where modern medicines are not accessible (Shaikh et al., 2009; Deepan et al., 2012). Eco-friendly and bio-friendly plant based commodities has recently been given consideration for the prevention and treatment of various human infections including microbial

diseases throughout the world (Dubey et al., 2004) and employment of plants in ethno medicine is on rise worldwide (Senthilkumar and Vijayakumari, 2012) *Cardiospermum halicacabum* L. belongs to family Sapindaceae. This herbaceous plant is extensively dispersed in tropical and subtropical areas of the world. This plant is produced in the plains of Africa, America, Bangladesh, India and Pakistan. Its general names include: balloon vine, heart vine, heart pea, love-in-a-puff,

heart seed (Shareef et al., 2012) and Kanphuti (Sheeba and Asha, 2009). Its vernacular name (Tamil) is Mudakkathan. Its extract decreases body ache (Rajendran et al., 2008). The plant based herbal products like gel, cream, shampoo, spray etc. are present in the market and are helpful in dry itchy skin and scalp (Subramanyam et al., 2007) (Figure 1).

Description and geographical distribution

The herb is pubertal or almost glabrous, yearly or perpetually having slim twigs that climb by tendrillar hooks. Leaves are ternate bicomponent and leaflets acuminate at the top. The stem is 5-grooved, slim, and hairless to sparingly hairy. The leaf stalk is long, ridged, slim and with tiny stipules at the base. Its leaflets are mostly 3-part and pinnately lobed, having narrowed stalks (Duke and Ayensu, 1985) (Figure 2).

Flowers are white in colour and are small. Flowers are unisexual, obliquely zygomorphic, having straight pedicel. Fruits are membranous, depressed; pyriform casing branched at the angles (Duke and Ayensu, 1985). Seeds are black in colour having large white heart formed aril (Veerappan et al., 2012) (Figure 2). Flowering season of this plant goes from July to August and seed ripening season is from August to October. Petiole contains set of 3 leaflets. Wings are sparsely hairy which contain curved hairs. Leaflets are variable in shape, but ovate or narrowly ovate. Sepals are 4 which are generally ovate, imbricate, green, red shade with white boundaries and almost hairless. Petals are 4 in number having scale inside above the base of each petal, white to cream with yellowish edge and approximately without hair. The ovary is higher, 3-angled and 3-celled, with 1 ovule per cell. Ovary possesses 3 carpals, stigma is also 3, and ovules are present with axial placentation. It is variously hairy, having short columnar style and 3-lobed stigma. Fruit is a spherical casing, inflate, 3-lobed and 3-celled. Base is papery, green but reddish or with reddish veins (Duke and Ayensu, 1985).

This herb contains 16 species present in Brazil and among them, 12 species are found in South America. This plant exhibits mainly various chromosome number of the family, having metacentric and submetacentric chromosomes, some have subtelo-centric chromosomes, but lacking in telocentric chromosomes (Warrier, 1996). The roots, leaves and seeds of the herb are employed as herbal medication (Urdampilleta et al., 2013). Plant is reported to possess anti-inflammatory activity by reducing PLA2 activity that is concerned with inflammatory process (Chandra, 2013).

Phytochemical analysis

Phytochemical screening confirms the presence of

flavones, aglycones, triterpenoids, glycosides and a variety of fatty acids and volatile esters (Rao and Chandra, 2006). Other secondary metabolites reported include alkaloids, carbohydrates, proteins, saponins lignin, steroids, cardiac glycosides found in small quantities in the extracts (Deepan et al., 2012).

Nutritional value

Seed oil contains a number of fatty acids (Shareef et al., 2012). The oil is yellow in colour, clear having distinguishing smell with extractive value 28.8460%. Gas chromatography-mass spectrometry (GC-MS) analysis categorizes 27 elements link to various groups. The seed oil have erucic acid 43%, oleic acid (30%), eicosonic acid 12%, octanoic acid 4.57% and n-hexadecanoic acid 4.15% (Jayanthi et al., 2012), rich in triterpenoids (Ferrari et al., 1996). The presence of octanoic acid, dodecanoic acid, tetradecanoic acid, pentadecanoic acid and arachidic acids together with other components supports its use in anti-inflammatory activity. It further includes antioxidants like eicosonic (arachidic acid) and palmitic acid (hexadecanoic acid), stearic acid (octadecanoic acid) and lauric acid (dodecanoic acid). Its refractive index at 25°C is 1.4870. Its weight/ml at 25°C is 0.9011 g. Its acid value is 27.4014 and saponification value is 158.6257. Its iodine value is 78.1886 (Jayanthi et al., 2012).

Chemical constituents

β -Arachidic acid, apigenin, apigenin-7-O-glucuronide, chrysoeriol-7-O-glucuronide and 80 luteolin-7-O-glucuronide are the essential chemical components obtained from this plant (Khan et al., 1990; Subramanyam et al., 2007) along with two crystalline compounds beta-sitosterol and beta-D-glycoside (Ferrari et al., 1996). Rutin is also present in the plant, which is a flavonol glycoside contains flavonols quercetin and the disaccharide rutinose. To manage the oxidative stress produced by sunrays and oxygen, herb has several small molecular mass and oxidative constituents hence; it has been effectively employed in phytotherapy (Babu and Krishnakumari, 2005). More important components of this herb are saponin, L-amino acid, β sitosterol, quebrachitol, capric acid, arachidic fatty acid and DL-DOPA. In the GC-MS examination, 15 bio active phytochemical components for example, acetic acid, 1,6,10-dodecatriene, 7,11, dimethyl-3-methylene-(E)-, phenol, 2,6-bis (1,1-dimethylethyl)-4-methylmethylcarbamate, 3-O-methyl-d-glucose, 1,14-tetradecanediol, 3,7,11,15-tetramethyl-2-hexadecen-1-ol, phytol, pseudoephedrine, 2-propenamide, N-[2-(dimethylamino)ethyl], E-2-octadecadecen-1-ol etc. were recognized in the ethanol extract of the herb (Senthilkumar and Vijayakumari, 2012).



Figure 1. *Cardiospermum halicacabum* plant.
Source: Jayanthi et al. (2012).



Figure 2. Seeds of *Cardiospermum halicacabum*.
Source: Jayanthi et al. (2012).

Embryogenic corn of the herb possess additional whole carbohydrate, starch contents, sum of free amino acids, nucleic acids, phenols and ascorbic acid while its non-embryogenic corn showed elevated chlorophyll content, entire soluble sugar, protein, ammonia and enzymes like peroxidase and polyphenol oxidase (Jeyaseelan and Rao, 2005). Seed oil of the herb possessed 49% of a diester containing two fatty acid moieties esterified with 1-cyano-2-hydroxymethylprop-2-ene-1-ol and 6% of one more diester derived from 1-cyano-2-hydroxymethylprop-1-ene-3-ol. Second diester treatment with methanolic hydrogen chloride generates methyl 4,4-dimethoxy-3-(methoxymethyl) butyrate from the dihydroxynitrile moiety (Mikolajczak et al., 1970). Methyl esters from the herb produce a little quantity of a volatile ester, $C_6H_{18}O_5$. The compound acts as a fraction of glyceride or glyceryl ether and changed into the dimethylacetal ester in the inter esterification treatment (Hopkins et al., 1968).

Medicinal properties

This herb act as a diaphoretic, diuretic, emetic, laxative, refrigerant, stomachic and sudorific and has antibacterial (Dhar et al., 1968; Raman et al., 1998), anti-diarrheal (Rao et al., 2006), antioxidant activities (Kumaran and Karunakaran, 2006), suppresses TNF production (Babu and Krishnakumari, 2006), exhibits anticancer (Sheeba and Asha, 2006), vaso depressant (Gopalakrishnan et al., 1976) effect. This herb is also useful in curing of rheumatism, severe bronchitis and firmness of the appendages and snakebite (Abdulla, 1973; Gopalakrishnan et al., 1976; Nadkarni, 1976; Chopra et al., 1980; Joshi et al., 1992). Antiulcer (Sheeba and Asha, 2006), analgesic (Muthumani et al., 2010), antiparasitic, antimalarial (Wakko et al., 2005), antifilarial (Khunkitt et al., 2000), and antipyretic role were also accounted for this herb (Asha and Pushpangadan, 1999). Further in human

secondary blood mononuclear cells, the herbal ethanolic extract modulates formation of TNF and nitric oxide (Babu and Krishnakumari, 2006). This herb reveals strong *in vitro* hydroxyl radical scavenging and lipid peroxidation reduction. This herb was also devoid of any obvious sharp and temporary toxicity in rats (Sheeba and Asha, 2006). A comparatively varied interactive connection between the bioactive compounds of *Cardiospermum halicacabum* and the viral receptors is revealed by the molecular docking examination. A dock score calculates the viral receptor-plant compound-binding percentage. The binding energy exhibited that benzene dicarboxylic acid from the herb was completely tied up with HIV receptor.

The methanolic extract of the herb reduced the hepatitis B surface antigen (HBsAg) discharge considerably. The predominant components of the herbal extracts include triterpenes, saponins, sugars, phenolic groups, steroids, alkaloids, and amino acids. While the biological activity of the plant was accounted for by the saponins, alkaloids, (+)-pinitol, apigenium, luteolin, chrysoeriol (EAEMP, 1999), quebrachitol, proanthocyanidin, stigma sterol (Satyavathi et al., 1976), fatty acids (Abburra and Guzmann, 1986), 11-eicosenoic acid (Chisholm and Hopkins, 1958), triterpenoids, glycosides (Srinivas et al., 1998), sterols, tannins, and flavonoids (Chattopadhyay and Naik, 2007). Their antioxidant roles, scavenging capabilities, restoration of DNA and RNA production, and inhibition of viral entrance, or viral reproduction accounts for their anti-viral activity (Chattopadhyay and Naik, 2007; Naithani et al., 2008; Christopher and Wong, 2006). GC-MS analysis of its methanolic extract revealed the presence of 11 compounds that are benzene dicarboxylic acid, eicosonic acid, and phenanthrol and these might be employed as new curative lead compounds for developing drugs for combating HIV and HBV co-infection (Ragupathy et al., 2007).

In "Allergy Relief Liquid TM" and "Bio force Pollinosan® Tabs" marketed by Bio force USA, it is one of the important constituent as a natural cure for hay fever, allergies, sneezing, watery eyes, and allergic responses. For skin diseases such as inflammation, scaling, blisters/vesicles, burning and pain, one more US based company, Boericke and Tafel manufactures "Florasone *Cardiospermum* Cream" (Subramanyam et al., 2007). For the curing of rheumatism, backache, earache, and fever (Nadkarni, 1976) this herb is employed in Ayurveda and folk medication. This plant is employed in routine and it may be taken internally or can be applied externally as a type of mixture, decoction, paste or powder.

For treatment of infections associated with the nervous system, the root alone has been employed (Muthu et al., 2006; Subramanyam et al., 2007). The root is mucilaginous, emetic, laxative and anti-rheumatic while the seeds are employed as a stimulant for fevers and as a diaphoretic (Joshi et al., 1992). In Indian tradition, the root

is employed for nervousness and epilepsy curing (Venkateshbabu and Krishnakumari, 2006). From the epileptic foci in brain, the alcoholic root extract has capability to avoid the spread of seizure release. On STN-induced tremors, it did not display its anticonvulsant effect, therefore representing its glycine self-governing role. It also shows no effect on motor coordination in animals nearer to its LD₅₀ value. Though more were needed for elucidating precise mechanism for the activities exhibited by this plant, its general result in seizure models shows that it produces effect during GABA mediated neurotransmission (Dhayabaran et al., 2012). Root is diaphoretic and diuretic. The leaf juice is curative in earache (Jigna et al., 2005).

Plant juice is useful in amenorrhoea, gonorrhoea, asthma and in nervous system problems (Tewari and Chaturvedi, 1981, 1982; Pillai and Vijayamma, 1985; Nadkarni, 1976). In *in-vitro* tissue experiments, this herb exhibited antispasmodic and curare like activities. The efficacy of the herbal decoction in rheumatism, nervous illnesses, pain and as diuretic is being validated in Ayurveda (Pillai and Vijayamma, 1985).

The herb has reduced the elevated levels of entire hexoses, hexosamines, fucose and sialic acid (except kidney) in the plasma and tissues to normal levels. These hexosamines act as physiologic glucose sensors that perform role as an adaptor in redirecting surplus calories to storage as fat (Marshall, 2006). In conclusion, in leaf extract treated diabetic rats, the reduced hyperglycemic status might have been accountable for the reduced glycoproteins in plasma, liver and kidney. A considerable increase of serum alkaline phosphate, creatinine, blood urea nitrogen, uric acid, cholesterol and reduction of whole proteins and albumin have been reported in acetaminophen-induced nephrotoxic animals while pre-treatment of these animals with methanolic and petroleum ether extract of the plant works oppositely. In rats though, methanolic extracts generate improved results than petroleum ether extracts (Parameshappa et al., 2012).

The leaves are rubifacient and are excellent for arthritis and fever. The herb possesses tranquillizing effect on the central nervous system (Nadkarni, 1996). This plant is also effective in controlling severe dermatoses (Shakhtmeister and Sharipova, 1997). Ethanol extract of this herb is effective against the gastric ulcers that are produced by oral ingestion of absolute ethanol. Their inoculation to rats elevates gastric glutathione level and reduces alkaline phosphatase activity (Sheeba and Asha, 2006). The permanent damage of extracellular matrix (ECM) such as cartilage, tendon, and bone take place and includes the synovial joints in rheumatoid arthritis and osteoarthritis by the over-expression of matrix metalloproteinase (MMP)-collagenases, and is assisted by plant by collagenase reservation (Ganesan et al., 2001). Leaves and stalks of the plant are employed in the curing of diarrhoea, dysentery and headache (Kurian, 1995).

The herbal tea made no major alterations in the blood levels of carbamazepine or drug-related toxicity (Thabrew et al., 2004). In balb-c rats the plant increases the blood levels of theophylline. Therefore this herbal tea should be avoided by the patients treated with theophylline as it has ability to influence or increase the bioavailability of the recommendation drug (Thabrew et al., 2004). In parts of East and Central Africa, this plant is generally employed to cure signs of malaria (Waako et al., 2005).

In plasma and tissues of streptozotocin (STZ)-induced diabetic rats, the herbal ethanolic leaf extract produce antioxidant and antihyperlipidemic activity. In these rats there were elevation in the level of plasma and tissue of thiobarbituric acid reactive substances (TBARS) and lipid hydroperoxides. But administration of the plant lowers their levels. With this herb the level of plasma vitamin E is augmented, vitamin C and reduced glutathione reduced in plasma and tissues. With the application of the herb, enzymatic and non enzymatic variations reverted to the normal level. Elevated level of plasma total cholesterol, phospholipids, triglycerides, and free fatty acids has been observed in the STZ-induced diabetic rats but treatment with the plant brings them to their normal level. It also elevated plasma low-density lipoprotein (LDL-C) and very low-density lipoprotein (VLDL-C) and lowered high-density lipoprotein (HDL-C). Hence, it has been shown that in these rats the plant play antioxidant and hypolipidemic activity, and the existence of flavonoids, like apigenin and luteolin are responsible for this activity (Veeramani et al., 2010).

The anti-inflammatory activity of extracts of *Cardiospermum halicacabum* aerial parts were assayed in male albino rats using carrageenan-induced rat paw edema. *C. halicacabum* extract was maximally effective at a dose of 500 mg/kg. In the cotton pellet granuloma assay, these drugs were able to suppress the transudative, exudative and proliferative components of chronic inflammation. Further, it was able to lower the lipid peroxide content and gamma-glutamyl transpeptidase and phospholipase A2 activity in the exudate of cotton pellet granuloma. The increased alkaline phosphatase activity and decreased A/G ratio of plasma in cotton pellet granulomatous rats were normalized after treatments with *C. halicacabum* extract were able to stabilize the human erythrocyte membrane against hypotonicity-induced lysis. It is likely that it may exert their anti-inflammatory activity by inhibition of phospholipase A2, resulting in the reduced availability of arachidonic acid (a precursor of prostaglandin biosynthesis) and by stabilization of the lysosomal membrane system (Sadique et al., 1987). Antihyperglycemic role is also proved by plant (Veeramani et al., 2012). This herb considerably increases the entire white blood cell (WBC) count, bone marrow cellularity, α -esterase positive cells, relative organ weights of spleen and thymus. In CTX treated animals, it also increases the glutathione (GSH) level, decreased the elevated levels of alkaline

phosphatase (ALP), glutamic-pyruvate transaminase (GPT), liver lipid peroxide (LPO), and pro inflammatory cytokine TNF- α and also reduces levels of other cytokines like IFN- γ , IL-2, and granulocyte-macrophage colony-stimulating factor (GM-CSF) (Pratheeshkumar and Kuttan, 2010).

Antimicrobial property

The herbal leaf extract possesses antimicrobial activity against certain bacterial species i.e. *Staphylococcus aureus*, *Bacillus subtilis* and *Escherichia coli* and more useful against *E. coli* (Deepan et al., 2012). Its methanolic extracts are effective to gram-negative *Klebsiella pneumoniae*. The aqueous and alcoholic extracts showed this activity but the aqueous one has shown better activity than the alcoholic one. Zone of inhibition increased with increase of concentration (Deepan et al., 2012). *B. subtilis* and *B. cereus* related to Gram-positive bacteria possess more susceptibility to leaf aqueous extract than to *S. aureus* and *B. subtilis* exhibited greatest inhibition amongst them. Whereas the leaf aqueous extract were less effective to Gram-negative bacteria. Petroleum ether extract lack this ability. Ethanolic extracts showed considerable activity against Gram-positive bacteria especially against *S. aureus* (Girish et al., 2008) followed by methanolic extracts. All the extracts of the plant inhibits the growth of certain organisms but most active against Gram-positive bacteria. The ethanolic extract exhibited considerable activity against *S. epidermis* and *S. fecalis* while it showed moderate activity against *S. aureus* AB188, *Micrococcus luteus* and *Coryne bacterium hofmanu*.

The ethyl acetate fraction exhibited most marked activity against *Streptococcus fecalis*, *Staphylococcus epidermis*, *Micrococcus luteus*, *K. pneumonia* and significant antibacterial activity against *Shigella boydii*, *Salmonella typhi* and *Enterobactor*. The butanol extract were effective to *M. luteus*, *S. paratyphi B* and *Enterobactor* and showed modest activity against *S. epidermis*, *S. fecalis*, *S. typhi*, *S. paratyphi A* and *K. pneumonia*. Against *S. epidermis*, *S. fecalis*, *M. luteus* and *Pnemococci* the aqueous extract showed moderate antimicrobial activity while the oil fractions are effective against gram positive bacterial strains but exhibited considerable activity against *S. fecalis*, *B. cereus*, *Bacillus steadher*, *Shigella boydii*, *S. typhi*, *K. pneumonia* and *Enterobactor*.

In comparison to the standard antibiotics that is, ampicillin and amoxicillin, the ethanolic and oil fraction of the herb was evenly effectual against a few of the gram positive bacterial species. All types of the plant extracts exhibited the antimicrobial activity against the several microbes, but the aqueous fraction exhibited lowest inhibition against the fungus *C. albicans*. With the chloroform fraction against *S. aureus*, the zone of inhibition was greatest

compared to the alcohol and ether fractions against *E. coli* and *B. subtilis* (Veerappan et al., 2012).

Antifungal activity

All the herbal extracts have inhibition against the fungi *C. albicans* while alcohol extract exhibited highest activity than chloroform; ether and aqueous extract. The herbal extracts have high effective antifungal activity against *C. albicans* than the antibacterial activity against the bacteria mentioned (Warrier, 1976). Against *Saccharomyces cerevisiae* and *Aspergillus niger*, ethanolic extract of the plant was effective but ethanol, aqueous and oil extracts produce temperate activity against *C. albicans*. Seed oil is also valuable to animal pathogens. Finally it is concluded that presence of several chemical components which can be the part of novel bioactive compounds, the herbal extract possess large possible source of active antimicrobial agents (Shareef et al., 2012).

Anti-inflammatory activity

Ethanolic extract of this extract repressed the TNF- α induced DNA binding activity of NF- κ B. These indicate the anti-inflammatory and analgesic activity of the plant (Sheeba and Asha, 2009). In Chinese medication this herb has been employed for a long time. In the anti-inflammatory test in the liver tissue, its ethanolic extract amplified the activities of catalase (CAT), superoxide dismutase (SOD) and glutathione peroxidase (GPx) while in edematous paw tissue and in serum, it lessens the level of nitrite oxide (NO) and malondialdehyde (MDA). These results suggest that ethanolic extract act as a natural antioxidant and anti-inflammatory mediator (Huang et al., 2010). Lately, the anti-inflammatory role of rutin has been recognized (Selloum et al., 2003; Babu and Krishnakumari, 2005).

Adulticidal activity

Against blood starving mature female of *Culex quinquefasciatus*, *Aedes aegypti* and *Anopheles stephensi* mosquitoes, the hexane, ethyl acetate, benzene, chloroform and methanol extract of the plant exhibits adulticidal activity while against medically significant vector mosquitoes, the herbal leaf extract have extraordinary adulticidal role. In small reproduction places of restricted size around human residences this extract might be applied directly as adulticidal mediator (Selloum et al., 2003). The methanolic and benzene extract of the herb produced 100% mortality against *Culex quinquefasciatus* while *A. aegypti* achieved the absolute ovicidal activity for the methanolic extract. Therefore, the herbal crude extract possesses ability for combating *C.*

quinque fasciatus and *A. aegypti* mosquitoes (Govindarajan, 2011).

Anxiolytic activity

The plant root is an effective anxiolytic mediator. Its phyto constituents that are accountable for its anxiolytic actions were separated and recognized as cardiospermin, a cyanogenic glucoside which is a famous compound (Kumar et al., 2011).

Antidiarrheal activity

The local therapeutic practitioners in Gulbarga used a combination of entire herb for the treatment of diarrhoea. Yet, for its antidiarrheal role the herb has not been experimentally verified. To the standard drugs its antidiarrheal activity was equivalent. Due to the presence of tannins, flavonoids alkaloids (Rehaily et al., 2001), saponins, reducing sugars, sterols and triterpenes (Otshudi et al., 2000), this plant shows antidiarrheal activity. Tannins induce an antidiarrheal effect (Yu et al., 2000) while the flavonoids hinder intestinal motility and hydro-electrolytic emission (Carlo et al., 1993; Rao et al., 1997) that are changed in this intestinal state. They also inhibit the prostaglandin E₂ mediated intestinal secretion (Sanchez et al., 1997).

Antipyretic activity

This herb also possesses antipyretic activity against yeast-induced pyrexia in rats. Potent antipyretic ability has been exhibited by ethanol and n-hexane extracts of the herbal powder while its aqueous extract did not show this activity (Asha and Ushpangadan, 1999).

Antifilarial activity

The ethanol and aqueous extracts of the herb have antifilarial activity on mature worms and micro filariae of *Brugiapahangi*. Different experiments showed that mature worms were injured when they were cultivated in the aqueous extracts of the plant but did not affect movement except in high concentration while ethanolic extracts in higher concentration damage both the motion of mature worms and the discharge of micro filariae from females. Though, ethanolic extract quickly decreased the movement of micro filariae while aqueous extract has gentle but proper straight macro filaricidal action on *B. pahangi* (Khunkitti et al., 2000).

Cure for different ailments

Gastrointestinal problems

The herbal leaves are helpful in biliousness curing, and leaves decoction alleviate diarrhoea and dysentery. Its juice can be applied to treat haemorrhoids (Manandhar and Manandhar, 2002; Jayabalan, 2006).

Respiratory disorders

For cold and asthma the plant decoction is applied. In Nepal, its juice is helpful for asthma while in Hong Kong it is employed to treat pertussis (Panda, 2000; Mat-Salleh and Latiff, 2002).

Urogenital infections

The roots possess diuretic abilities and employed in the treatment of renal problems. A decoction of the herb together with *Vernonia cinera* and *Desmodium barbatum* is best suggested for kidney problems in Guyana. In Hong Kong and Korea the whole herb is employed for the treatment of urinary tract infection, oedema, nephritis and oliguria (Panda, 2000).

Conclusion

Cardiospermum halicacabum L possess certain significant properties that support its role in medicinal field. It possesses anti-inflammatory, antidiarrheal, antiparasitic, antipyretic, antifilarial, anxiolytic, adulticidal activities, urinary tract infections suppression and antihyperglycemic properties. It also plays important role in epilepsy and certain nervous disorders. Its chemical constituents are well documented and further investigations are needed to assess its isolates mode of action on various activities.

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