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Mariyam Farisha A

Division of Pharmacognosy & Phytochemistry Research Laboratory, Nehru College of Pharmacy, Pampady, Thiruvilwamala, Thrissur, Kerala, India

KP Jaiganesh

Associate Professor, Division of Pharmacognosy & Phytochemistry Research Laboratory, Nehru College of Pharmacy, Pampady, Thiruvilwamala, Thrissur, Kerala, India

Corresponding Author:**KP Jaiganesh**

Associate Professor, Division of Pharmacognosy & Phytochemistry Research Laboratory, Nehru College of Pharmacy, Pampady, Thiruvilwamala, Thrissur, Kerala, India

Review on Ethnobotany and phytopharmacology of *Cardiospermum halicacabum* Linn. (Sapindaceae)

Mariyam Farisha A and KP Jaiganesh

Abstract

Herbal plant serves as a vital source for curing various acute and chronic disorders for both human and animals. Those herbal medicines are used to treat common ailments and various life threatening disorders. Medicinal plants were used extensively in the present world because of its safety, efficacy and having a little or no side effects. In this review article, the major phytochemical constituents which are involved for the pharmacological properties of *Cardiospermum halicacabum* Linn are summarized. Secondary metabolites include phenols, polyphenols, phytosterols, tannins, saponins, flavonoids, sugars, steroids, lignins, cardiac glycosides, aminoacids are present. Pharmacological activities like anti-microbial, anti-inflammatory activity, analgesic, anti-parasitic, anti-filarial, anti-malarial, anti-histaminic, anti-anxiety, nephroprotective, anti-ulcer, antipyretic, anti-diarrhoeal activity, anti-hyperglycemic activity are showed.

Keywords: Balloon vine, *Cardiospermum halicacabum*, pharmacological activity, phytochemical analysis, therapeutic uses

Introduction

Cardiospermum halicacabum Linn also known as heart seed or balloon plant or love in a puff, or heart pea belongs to Sapindaceae family. It is a perennial species, climbing or creeping herbaceous plant, widely distributed in tropical and subtropical Africa, Asia, Australia, North and South America and is one among the "Ten Sacred Flowers of Kerala," are known as Dasapushpam. The stem as grooved, forms internodes between 6 to 10cm in length. The leaves are trifoliolate, biternate and about 5 to 7 cm long, leaflets are ovate to lanceolate and acuminate at top. The fruit is obovoid, about 2cm long, three keeled and inflated capsule. Unisexual flower consists of 2 to 5 cm long, zygomorphic in nature, white colour with yellowish centre. *Cardiospermum* derived from the peculiar appearance of the black coloured, light heart shaped seeds. *Halicacabum* comes from the name as salt cellar (Greek word), deciduous climbing shrub branched from the base and growing about 3 metres. Prefers moist soil and a sunny sheltered position for cultivation. A fast growing plant can flower and fruit all year round, except during prolonged periods of drought; petioles has three set leaflets; flowering season mainly from July to august and fruit ripening season is from august to October [1]. Secondary metabolites include flavonoids, triterpenoids, phenols, aglycones, fattyacids, glycosides and volatile esters, polyphenols, phytosterols, tannins. Other secondary metabolites include sugars, steroids, lignins, cardiac glycosides, aminoacids are present in small amount. Also, β -arachidic acid, apigenin, apigenin-7-o-glucuronide, chrysoeriol-7-o-glucuronide, along with β -sitosterol and β -D-glycoside (crystalline compound) etc are present [2].

Synonyms

Cardiospermum corindum
Cardiospermum ovatum
Cardiospermum grandiflorum
Cardiospermum hirsutum
Cardiospermum vesicarium
Cardiospermum glabrum
Cardiospermum microspermum
Cardiospermum inflatum [3]

Scientific classification

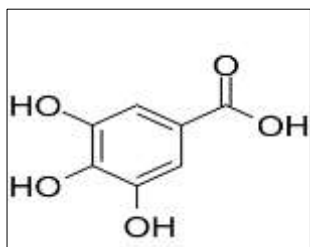
Kingdom : Plantae
 Phylum : Spermatophytae

Subphylum : Angiospermae
 Division : Tracheophytae
 Class : Magnoliopsida
 Order : Sapindales
 Family : Sapindaceae
 Genus : *Cardiospermum*
 Species : *halicacabum* [4]

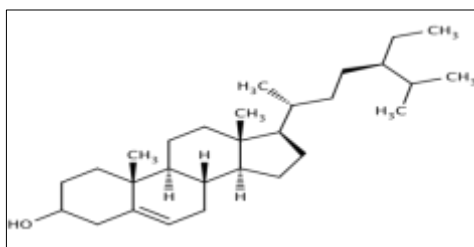
Phytochemical analysis

The crude plant extracts previously prepared and stored in a refrigerator which were used for the phytochemical screening tests [11]. Phytochemical investigation of *Cardiospermum halicacabum* L revealed the presence of flavones, glycosides, aglycones, proanthocyanidins, volatile esters, fattyacids, triterpenoids, saponins, hydrolysable tannins, traces of

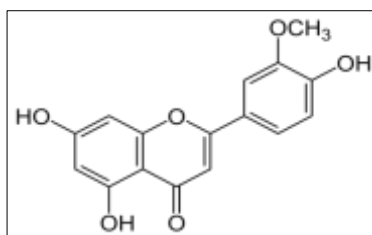
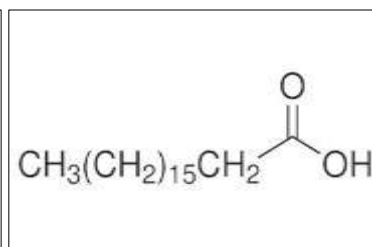
alkaloids, quebrachitol, inositol, anthracene glycosides, flavonoids such as apigenin, pinitol, luteolin, chrysoeriol, penta cyclic triterpenes (glutinone, β -amirenone, β -amyirin), sterols (β - sitosterol, stigmasterol), seed oil contains fattyacids and which consists of cyanolipids (13-55%) [5]. Fatty acids like 11-eicosinic acid (major one), other chief fatty acids like oleic acid, arachidonic acid, stearic acid and linoleic acid. The leaves also contain an alkaloid, β -sitosterol, and it's D-glucoside, oxalic acid and amino acids [6]. Rutinis are also present as a major constituent in plant, which acts as a flavonol glycoside contains flavonols quercetin and the rutinose as disaccharide. Herb has small molecular mass and oxidative constituents which are used in phytotherapy for the management of oxidative stresses [2].



Gallic Acid



Beta-Sitosterolstearic Acid



Chrysoeriol

Therapeutic uses

Cardiospermum halicacabum Linn used for the treatment of hair growth, herbal treatment for skin redness, psoriatic action, anti-pruritic action, to treat ear ache, scalp treatment, used as a modulators in various reactions. Root as mainly used as diuretic, diaphoretic, emetic, laxative, stomachic, sudorific, amenorrhoea, eczema, arthritis, nervous diseases, rubefacient, prepare paste with treatment of rat bite, and spider poisoning. Treatments of chronic bronchitis, snake bites, stiffness of limbs are used in Indian system of medicine. Leaves used as arthritis, rubefacient, hair growth, ophthalmodynia. Also used to treat rheumatism, nervous diseases, amenorrhoea, lumbago, psoriasis, demulcent in orchitis. Seeds mainly used for tonic, diaphoretic, treatment for fever and also have anti-bacterial activity. The whole plant has analgesic and anti-inflammatory activity, as well as sedative action on the central nervous system [6].

Ethnomedical uses

Juices of herb used to cure ear ache, and reduced hardened tumours [7]. Leaf mixed with castor oil is administered for the treatment of rheumatism, orchitis, and to check lumbago [8]. Plant decoction used in rheumatism, nervous diseases, pain and as diuretic [2]. Plant juice are useful for gonorrhoea, amenorrhoea, asthma and other nervous disorders [2]. Young shoots used as stomachic, vegetable, diuretic, rubefacient etc. [9]

Pharmacological activities

Plant exhibits activities like anti-microbial, anti-inflammatory, anti-diarrhoeal, anti-tumor, anti-convulsant, anxiolytic, anti-pyretic, anti-parasitic, anti-histaminic, anti-diabetic, anti-malarial, anti-ulcer activity [10].

Anti-bacterial activity

Several plant exhibits anti-bacterial activity against bacterial substances without producing any side effects. In *Cardiospermum halicacabum* plant, anti-bacterial screening against Gram +ve and Gram-ve bacteria by using solvents like acetone, alcohol, benzene, chloroform, and aqueous extracts of leaf and stem. Acetone and chloroform extracts of leaf has more inhibition against *Salmonella typhi* and *Streptococcus subtilis*. Acetone extracts inhibition against *Salmonella typhi* and benzene extract against *E.coli*. Aqueous extracts shows zone of inhibition from 7mm to 9mm against Gram -ve and Gram +ve strains [11].

Anti-fungal activity

Plant extract *Cardiospermum halicacabum* exhibits inhibition against the fungi as *Aspergillus niger*, *Candida albicans* (human pathogens), *Microsporillum gypsicus*, *Microsporillum canis*, *Trichophyton mentagrophyte*, (animal pathogens), and *Saccharomyces cerevisiae*, *Rhizopus* species, *Penicillium* species (plant pathogens). Phytochemical analysis investigate the presence of tannins, saponins, sugars, and terpenes in plant extracts which shows the anti-fungal activity of whole plant [12].

Anti-parasitic activity

The aqueous and alcoholic extracts of *Cardiospermum halicacabum* tested *in vitro* for effectiveness against third stage larvae of *Strongyloides stercoralis* (infective stage), were isolated from cultures from dog's faeces by using agar plate culture method ^[13].

Anti-filarial activity

Elephantiasis is a lymphatic filariasis caused by worms like *Wuchereria bancrofti*, *Brugiamalayi* and *Brugiatimori* transmitted by mosquitoes. Ethanol extract of *Cardiospermum halicacabum* leaf shows more effect compared to aqueous extract on the viability of microfilarial stage of parasite by induction of apoptosis ^[14].

Anti-diarrhoeal activity

Diarrhoea was impelled by administering castor oil to the experimental models. Alcoholic and aqueous extracts of leaves of plant shows dose dependent anti-diarrhoeal activity in 3 experimental models by decreasing defecation frequency and also decrease intestinal secretions ^[15].

Anti-cancer activity

Cancer as a 2nd cause of death after cardiac disease in the universe. Methanolic extract of *Cardiospermum halicacabum* exhibits anticancer activity against the breast cancer cell lines due to the phytoconstituent, MCF-7. Chloroform extracts of *Cardiospermum halicacabum* against Ehrlich ascites carcinoma cell lines ^[16].

Anti-malarial activity

Ethyl acetate extracts of *Cardiospermum halicacabum* exhibits anti-malarial activity in limited amount, and also shows activity against chloroquine and sulphonamide resistant K1 parasites ^[5].

Anti-inflammatory activity

Cardiospermum halicacabum extracts are used for rheumatism as folk medicine. Carrageenan induced inflammation is an evaluation method for anti-inflammatory activity. Intradermal injection of 1% w/v carrageenan in saline which induces oedema in left hind paw. Ethanol extracts of leaves of plant at a dose of 125 and 250mg/kg as Freund's complete adjuvant induced arthritis in rats. This treatment is detected by measuring the paw volume by using Haemoglobin (Hb), ESR count, RBC, WBC counts and other haematological parameters. The plant contains major flavonoid as rutin (flavonol) glycoside, quercetin and sugar runinose, which decrease glutathione level in colon region and reduce inflammation by inhibiting NO (Nitric oxide) level in serum and α -TNF production which exhibits anti-inflammatory activity ^[17].

Anti-diabetic activity

Diabetes is a metabolic disorder, pancreas doesn't produce enough insulin to control blood glucose level. Ethanol extract of plant works against Streptozocin-induced diabetic rats. Good anti-diabetic results by the presence of flavonoids such as apigenin, luteolin in plant extracts. The leaf extracts of *Cardiospermum halicacabum* helps to increase the activity of enzyme glucokinase and decrease the activity of Glucose-6-phosphatase in liver ^[10].

Anti-oxidant activity

Anti-oxidants as a limitation of oxidation of proteins, lipids, DNA by blocking propagation stage on oxidative chain

reactions. Chloroform and ethanolic extracts of plant using free radical models such as DPPH, reducing power assay, Nitric oxide scavenging activity, H₂O₂ scavenging activity, Superoxide scavenging activity and ABTS assay. Methanolic extracts of plant inhibits 2,2-diphenyl-1-picryl hydrazyl radical because of its large content of phenolic compounds which exhibits strong free radical scavenging which measures the extent of anti-oxidant activity to prevent oxidative damage by free radical mediated ^[18].

Anti-arthritis activity

Rheumatoid arthritis is a chronic inflammatory disorder attacks own tissue (auto immune disorder) including joints. Ethanol extracts of plant are administered orally at the dose of 125 and 250mg/kg as Freund's complete adjuvant induced arthritis in rats, treatment is detected by measuring paw volume by using haematological parameters. Anti-arthritis activity is induced because of phytoconstituents like luteolin-7-o-glucuronide, chyoeriol, apigenin-7-o-glucuronide) ^[19].

Anti-anxiety activity

Mental health disorder characterized by feeling of anxiety, obsessive compulsive disorder. Alcoholic and aqueous root extracts of plant (100 or 300mg/kg) are injected into mice 1hour before subjecting the animals to anxiety experimental models. Anti-anxiety activity was evaluated by using light dark model, open field test ^[20].

Anti-ulcer activity

Ethanol extract of *Cardiospermum halicacabum* induced to rats by oral administration which inhibited gastric ulcers results decrease the level of enzyme alkaline phosphatase, and increase in level of gastric glutathione enzyme ^[5].

Anti-histamine activity

Cardiospermum halicacabum plant extract shows Cortisone like action which controls the problems of dermatitis, seborrhoeic dermatitis, sun rashes, keratosis, and lichenification without causing the collateral effects by using anti-histamine preparations. Phytoconstituents present in plant extracts such as sterols (β -sitosterol, stigmasterol), flavonoids (apigenin, luteolin), saponins, quebrachitol, inositol, penta cyclic triterpenes are exhibits the particular activity ^[21].

Conclusion

The *Cardiospermum halicacabum* has enormous medicinal value, which is used to treat various acute and chronic diseases because of the presence of phytoconstituents in the plant extract. This present article which shows the traditional uses and pharmacological activities of *Cardiospermum halicacabum* as well as vital constituents such as flavonoids, saponins, terpenoids, glycosides, alkaloids, anthracene glycosides present in the plant extract which are responsible for the multiple benefits of *Cardiospermum halicacabum*. The plant as true miracle in nature because of its vital therapeutic purpose in both for human and animals. More research works are required about the better therapeutic agents from natural sources which are also seeking by people they were believed to be more efficient and safety with little or no side effects those when compared to today's synthetic drugs.

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