



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Review Article

A Review on Phytochemical and Pharmacological Investigation of *Cardiospermum Halicacabum L* (Sapindaceae)

Dr. Aparna Baliwada*, Akshitha Pothu, Keerthana Puligilla, Rakesh Mudavath, Dr. G. Tulja Rani

Department of Pharmaceutical chemistry, Malla Reddy Pharmacy College, Maisammaguda, Dhulapally, Secunderabad-500100

ARTICLE INFO

Published: 16 Jun. 2025

Keywords:

Cardiospermum halicacabum, Antioxidant, Anti-Sickling, Anti-Filarial, Adulticidal, Anxiolytic

DOI:

10.5281/zenodo.15677304

ABSTRACT

As natural sources of bioactive substances, medicinal plants have long been important to both conventional and alternative medicine. The rapidly growing climber *Cardiospermum halicacabum*, often called balloon vine, belongs to the Sapindaceae family and is valued for its ethnobotanical and varied medicinal uses. This plant, which grows throughout South America, Africa, and India, has been used for millennia in Ayurvedic and traditional medicine to cure a variety of illnesses. The goal of this project is to present a thorough investigation of *Cardiospermum halicacabum*'s phytochemical composition, medicinal potential, and traditional uses. Flavonoids, alkaloids, terpenoids, tannins, saponins, glycosides, essential oils, and fatty acids are just a few of the many bioactive components that give it its therapeutic qualities. Antioxidant, antibacterial, anti-inflammatory, anti-diabetic, anti-cancer, anxiolytic, and anti-arthritis properties have been shown in the plant, which makes it a viable target for pharmaceutical development. Rheumatism, fever, stomach issues, skin conditions, and snake bites are among its traditional uses. This study uses pharmacological validation, microscopic investigation, and phytochemical profiling to support its therapeutic efficacy. Its ecological importance, regional distribution, and influence on conventional medical systems will also be investigated. The study intends to close the gap between conventional wisdom and contemporary pharmacology by means of a thorough scientific examination, advancing its possible uses in integrative medicine and drug development. The results of this study will support conservation initiatives, sustainable healthcare practices, and the wise use of *Cardiospermum halicacabum* as a useful ethnobotanical resource.

***Corresponding Author:** Dr. Aparna Baliwada

Address: Department of Pharmaceutical chemistry, Malla Reddy Pharmacy College, Maisammaguda, Dhulapally, Secunderabad-500100

Email ✉: aparnabaliwada@gmail.com

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



INTRODUCTION

Medicinal plants continue to inspire advances in contemporary medicine and serve as the basis for traditional healing methods. One such amazing plant is *Cardiospermum halicacabum*, sometimes known as the balloon vine and a member of the Sapindaceae family. In tropical and subtropical areas, such as Asia, Africa, and the Americas, this climbing herb grows well. The plant, which gets its name from the Latin words "cardio" (heart) and "sperma" (seed), is known for its heart-shaped seeds, which represent its distinct identity and importance in both cultural and medicinal traditions [1]. *Cardiospermum halicacabum* is known for its wide range of medicinal uses and has long been incorporated into traditional medical systems including Ayurveda, homeopathy, and unani. The plant is used to cure a wide range of illnesses, such as fevers, gastrointestinal issues, skin concerns, joint problems, and even snakebite. According to the Ayurvedic pharmacopoeia, its root is a necessary treatment for ailments including jvara (fever), kusta (skin problems), and sandhivata (joint diseases). The reason for its extensive use is its diverse phytochemical profile, which consists of alkaloids, flavonoids, saponins, tannins, and glycosides. Numerous pharmacological characteristics, such as anti-inflammatory, antioxidant, anti-cancer, anti-diabetic, and antibacterial activities, are displayed by these bioactive substances [2]. In addition to its therapeutic uses, *Cardiospermum halicacabum* is

a food resource that promotes dietary health, especially in parts of India where its leaves and shoots are eaten as green vegetables. Compounds including beta-sitosterol, amino acids, and essential fatty acids are found in the plant and are used to create medicinal and nutraceutical goods, which gives it considerable commercial potential [3]. Its designation as an invasive species in some places, however, presents ecological difficulties and calls for sustainable management strategies to strike a balance between its advantages and effects on nearby ecosystems. Furthermore, the pharmacological potential of *Cardiospermum halicacabum* in tackling global health issues like preventing drug-resistant infections and reducing chronic illnesses is being intensively investigated by contemporary scientific research. Research has also emphasized its antioxidant properties, which aid in lowering oxidative stress and the hazards it carries, including cancer and cardiovascular diseases. The plant is of interest to a wide range of academic fields, including environmental science, medicine, and agriculture, due to its adaptability, therapeutic qualities, and economic worth. The goal of this review paper is to present a thorough analysis of *Cardiospermum halicacabum* by combining current research findings with traditional knowledge. Through an analysis of its pharmacological, nutritional, ecological, and commercial relevance, this paper aims to highlight *Cardiospermum halicacabum*'s potential as an essential resource for economic growth, sustainability, and health [1,2,3].





Fig-1 Balloon Vine Plant

GEOGRAPHY

The **geography of *Cardiospermum halicacabum***, commonly known as the **balloon vine**, spans tropical and subtropical regions worldwide. This adaptable climbing herb is native to **Asia, Africa, and the Americas**, thriving in diverse climatic conditions.

Botanical name: *Cardiospermum halicacabum* Linn.

Synonyms: *C. corundum* L., *C. glabrum*, *C. inflatum*

Family: Sapindaceae

Common names: Heart pea, Puff-ball, Balloon vine, Heart seed Vine, Love in a puff.

Part used: Fruits, Leaves and seeds

Growth Habit: Vine, Forb/ herb.

It thrives in warm, humid climates and is frequently found in forests, grasslands, agricultural fields, and along roadsides, where it spreads rapidly due to its climbing nature. Preferring moist, well-drained soil, the plant grows in both shaded and sunny areas and is commonly

found at low to mid elevations below 2,000 meters. In regions like India, its leaves and shoots are consumed as vegetables, contributing to local diets. Despite its medicinal and commercial value, *Cardiospermum halicacabum* is considered invasive in certain regions, including parts of Australia and the United States, where it competes with native flora. In sustainable farming, it is sometimes used for soil stabilization and erosion control due to its fast-growing and adaptive properties [4]. The plant's ability to flourish in disturbed environments has enabled its expansion beyond its native range, making it an ecologically significant species that requires careful management. With continued research and cultivation efforts, its medicinal benefits can be further harnessed while mitigating its impact as an invasive species.

Taxonomical Classification

Kingdom: Plantae

Phylum: Angiosperms (Magnoliophyte)

Class: Eudicots (Magnoliopsida)

Order: Sapindales



Family: Sapindaceae

Genus: *Cardiospermum*

Species: *Cardiospermum halicacabum*

MORPHOLOGY

The morphology of *Cardiospermum halicacabum*, commonly known as the balloon vine, is distinctive and aids in its identification. It is a climbing herb with slender green stems, approximately 0.2–0.3 cm wide, and bi-ternate leaves. These leaves have ovate-lanceolate, smooth, and glabrous leaflets with dentate margins, measuring 3–5 cm in length and 1.5–2 cm in width, and are supported by petioles 1.5–2.5 cm long. The plant produces tetramerous flowers, characterized by 2+2 sepals, 2+2 equal petals, and 8 unequal stamens. Its ovary is tricarpellary, with each carpel containing a single ovule and topped with a trifid stigma. The fruits are globose capsules with winged, bloated structures, giving the plant its unique "balloon vine" appearance. These morphological features, combined with its climbing nature and tendrils, make it well-suited to thrive in diverse environments [5].

Nutritional Values

Cardiospermum halicacabum seed oil has a rich profile of bioactive chemicals and fatty acids, which makes it useful for both nutritional and therapeutic uses. The oil has a 28.8460% extractive content and is bright, transparent, and distinctly fragrant. 27 distinct components were found by gas chromatography-mass spectrometry (GC-MS) analysis, including n-hexadecenoic acid (4.15%), oleic acid (30%), eicosonic acid (12%), octanoic acid (4.57%), and erucic acid (43%). Its anti-inflammatory properties are reinforced by the presence of triterpenoids and fatty acids, including arachidic, octanoic, dodecanoic, tetradecanoic,

and pentadecanoic acids [6]. Antioxidants including lauric acid, stearic acid, palmitic acid, and arachidic acid are also present in the oil, which helps to protect against oxidative stress. The oil's physical and chemical characteristics include a density of 0.9011 g/mL, a refractive index of 1.4870 at 25°C, an acid value of 27.4014, a saponification value of 158.6257, and an iodine value of 78.1886. These traits support its importance as a plant-based medical resource by indicating that it is suitable for use in pharmacological, cosmetic, and nutritional applications [7].

Chemical Composition

Its antioxidant, anti-inflammatory, and antidiabetic qualities are attributed to its phytochemical composition, which also includes phenolic acids, flavonoids, tannins, sterols, and mucilage. The aqueous and ethanolic extracts contain important bioactive substances, such as L-quebrachitol and pinitol, which are well-known for their pharmacological advantages in the treatment of neurological illnesses, cardiovascular diseases, and diabetes. Its mucilage, which is high in carbohydrates and non-toxic and biocompatible, can be used as a natural thickening agent in pharmaceutical applications. Further boosting its nutritional and therapeutic potential, mineral analysis also identifies vital macronutrients (nitrogen, phosphorus, potassium) and micronutrients (iron, manganese, copper, and zinc) [8]. Even though *C. halicacabum* has therapeutic value, some areas view it as an invasive plant, hence sustainable growing methods are required. While minimizing its ecological impact, ongoing research attempts to maximize its economic and medical uses.

Phytochemical Constituents



Cardiospermum halicacabum's therapeutic importance is attributed to the variety of its phytochemical ingredients. Research conducted on its ethanolic leaf extract has identified flavonoids, phenolic acids, tannins, alkaloids, glycosides, sterols, and saponins, all of which have pharmacological characteristics including anti-inflammatory, antidiabetic, and antioxidant activities. While GC-MS analysis has verified the presence of 24 chemicals, including caryophyllene, phytol, benzene acetic acid, neophytadiene, and cyclohexane-1, FT-IR spectral analysis has revealed alcohols, phenols, alkynes, alkanes, and aliphatic esters. Furthermore, luteolin-7-O-glucuronide, ricinolenic acid, oleic acid, linoleic acid, β -sitosterol, and other bioactive components have been extracted from various plant extracts. With 27 components found by GC-MS analysis of seed oil, the plant's potential for nutraceutical uses is highlighted by the presence of octanoic acid (4.57%), oleic acid (30%), and erucic acid (43%). Terpenoids, quinones, proteins, carbohydrates, and steroids have all been verified by phytochemical testing, and mucilage-rich aqueous extracts have shown biocompatibility for use in medicinal formulations. Its nutritional and therapeutic value is further increased by vital mineral components like iron, manganese, copper, zinc, phosphorus, potassium, nitrogen, and phosphorus. Research on *C. halicacabum*'s uses in natural medicine, drug discovery, and plant-based pharmaceutical formulations is still underway due to the variety of bioactive chemicals it contains [9].

Pharmacological Activities Of Balloone Vine

Cardiospermum halicacabum exhibits diverse pharmacological activities, making it a significant medicinal plant in traditional and modern medicine. It has been extensively studied for its **anti-inflammatory, antioxidant, antimicrobial**

(antibacterial and antifungal), antidiabetic, hepatoprotective, analgesic, and antiarthritic properties, contributing to its effectiveness in treating joint disorders and inflammatory conditions. Additionally, it demonstrates **neuroprotective, wound healing, immunomodulatory, cardioprotective, gastroprotective, and antidiarrheal** effects, supporting applications in digestive and cardiovascular health. Its **anti-stress and adaptogenic** potential aids in stress management, while its **antiparasitic and antihelmintic** activities highlight its role in combating intestinal parasites. Preliminary studies suggest it possesses **anticancer, antipyretic, antimalarial, and snake venom neutralizing** properties, reinforcing its traditional use in treating fevers, infections, and toxic exposures. The broad spectrum of bioactive compounds found in *C. halicacabum* underpins these pharmacological effects, making it a valuable natural resource for drug development and therapeutic applications.

Anti-Inflammatory Activity:

The anti-inflammatory activity of *Cardiospermum halicacabum* is attributed to its ability to modulate key inflammatory pathways. Studies on its ethanolic extract indicate a significant inhibition of carrageenan-induced paw edema in mice, demonstrating its effectiveness in reducing inflammation. The extract enhances the activity of glutathione peroxidase (GPx), superoxide dismutase (SOD), and catalase (CAT) in liver tissue, reinforcing its antioxidant-driven anti-inflammatory effects. Additionally, it suppresses TNF- α -induced DNA binding activity of NF- κ B, a critical mediator of inflammation, confirming its analgesic and anti-inflammatory potential [10]. In edematous paw tissue and serum, the extract reduces nitric oxide (NO) and malondialdehyde (MDA) levels, further supporting its role as a



natural antioxidant and anti-inflammatory agent. The long-standing use of this plant in Chinese medicine for inflammatory conditions aligns with recent findings, and research has also highlighted the anti-inflammatory role of rutin, a flavonoid present in *C. halicacabum*, further enhancing its medicinal value. These combined effects suggest that *C. halicacabum* holds promise as a therapeutic agent for inflammatory disorders [11].

Antioxidant Activity:

The antioxidant activity of *Cardiospermum halicacabum* has been confirmed through various *in vitro* assays, including DPPH, reducing power, and nitric oxide scavenging [12]. Methanolic extracts demonstrated strong free radical scavenging, particularly in β -carotene-linoleate systems, with phenolic content playing a crucial role. Chloroform extracts showed higher antioxidant potential compared to ethanolic extracts. Fresh plant extracts exhibited elevated phenolic content and ferric reducing power, while microwave drying reduced antioxidant efficacy. Its ability to neutralize reactive oxygen species highlights its therapeutic relevance in managing oxidative stress-related chronic disorders like cancer, arteriosclerosis, and rheumatism [13].

Anxiolytic Activity:

Cardiospermum halicacabum root extracts in alcoholic and aqueous formulations in mice exposed to anxiety models such as the Light-Dark Model (LDM), Elevated Plus Maze (EPM), and Open Field Test (OFT). A decrease in anxiety-like behaviour was indicated by increased time spent in the open arm (EPM), light compartment (LDM), and central area (OFT) following oral administration of 100 or 300 mg/kg of extracts an hour prior to testing [14]. The plant's root extracts contain a cyanogenic glucoside called cardiospermin, which is thought to have anxiolytic

properties. The results indicate that *C. halicacabum* may be a viable natural remedy for anxiety, which calls for more research to validate the processes and possible therapeutic uses [15].

Anti-Microbial Activity:

Cardiospermum halicacabum's bioactive phytochemicals give it potent antibacterial activity against a range of Gram-positive and Gram-negative bacteria as well as some fungi. Ethanolic extracts exhibit significant activity against *Staphylococcus aureus* and *Escherichia coli*, while extracts employing solvents such as alcohol, chloroform, acetone, benzene, and aqueous solutions exhibit a range of inhibitory effects. Acetone and chloroform extracts are especially effective against *Salmonella typhi* and *Streptococcus subtilis*. While butanol and ethyl acetate extracts work well against *Enterobacter*, *Shigella boydii*, and *Streptococcus faecalis*, aqueous extracts are more efficient against Gram-positive bacteria such as *Bacillus cereus* and *Bacillus subtilis*. In addition, green nanoparticles made from plant extracts improve antibacterial activity, confirming the plant's traditional use and emphasizing its potential for use in medicine [16].

Anti-Fungal Activity:

The antifungal properties of *Cardiospermum halicacabum* extract are demonstrated against *Candida albicans* and *Trichophyton rubrum*. Important chemicals luteolin and rutin increase the fungistatic effects of Hsp90 by inhibiting it. This natural antifungal medication for dermatophytosis has a MIC of 190 μ g/ml against *Candida albicans* [17].

Anti-Diabetic Activity:

The study uses an *in vitro* method to examine the inhibitory effect of *Cardiospermum halicacabum*



leaf extracts, such as n-hexane, ethanol, methanol, and aqueous extracts, on glucose utilization in order to assess their potential as antidiabetic agents. The greatest effect was exhibited by the methanol extract at a concentration of 50 g/l, which after 27 hours had the lowest mean glucose concentration of 201.69 mg/dl, indicating that it was successful in preventing glucose diffusion. In addition to confirming the plant's traditional therapeutic usage, the study finds that methanol is the most effective extraction solvent. Nevertheless, the results are restricted to in vitro settings, and additional in vivo research is necessary to validate the effectiveness and safety of these extracts for real-world medical uses. [18].

Anti-Sickling Activity:

The extract from *Cardiospermum halicacabum* exhibits anti-sickling and anti-crenation properties, more successfully reversing RBC sickling and crenation than testosterone propionate. Although active chemicals are being studied for their potential as a treatment for sickle cell disease, its exact mechanism is still unknown [19].

Anti-Arthritic Activity:

The anti-arthritic properties of *Cardiospermum halicacabum* have been demonstrated in experimental studies using its ethanolic leaf extract on Freund's complete adjuvant (FCA)-induced arthritis in rats. The extract was orally administered at doses of 125 mg/kg and 250 mg/kg, showing a dose-dependent inhibition of arthritis progression. Notable improvements in haematological parameters, including haemoglobin (Hb), total red blood cell (RBC) count, white blood cell (WBC) count, and erythrocyte sedimentation rate (ESR), were observed, along with significant increases in body weight. The higher dose of 250 mg/kg exhibited

more pronounced effects, comparable to the standard anti-arthritic drug Indomethacin (10 mg/kg). These results affirm the potential of *C. halicacabum* as a natural anti-arthritic agent, offering therapeutic benefits for rheumatoid arthritis and other inflammatory disorders [20].

Anti-Diarrheal Activity:

Cardiospermum halicacabum leaf extracts, both alcoholic and aqueous, have shown strong anti-diarrheal properties in experimental models, especially when castor oil is used to induce diarrhoea. Research shows that these extracts impede the passage of charcoal meal through the digestive tract, decrease the weight of moist faeces, and decrease the pace of defecation. Furthermore, they aid in reducing intestinal edema, indicating that they have anti-inflammatory qualities. Active ingredients such as tannins, flavonoids, alkaloids, saponins, sterols, and triterpenes are primarily responsible for this plant's medicinal potential since they have astringent and motility-inhibiting properties. The entire herb has long been utilized by Gulbarga traditional healers to cure diarrhoea, and studies indicate that its effectiveness may be on par with that of prescription medications [21].

Anti-Parasitic Activity:

The research uses an in vitro method to examine *Cardiospermum halicacabum's* anti-parasitic potential against third-stage larvae of *Strongyloides stercoralis*. In addition to common medications piperazine and ivermectin as controls, larvae were cultured from dog feces using agar plates and subjected to alcoholic and aqueous extracts of *C. halicacabum* at 37°C with 5% CO₂. When exposed to *C. halicacabum* extracts, the results demonstrated that many larvae became immobile in 48–72 hours, while piperazine took more than seven days and ivermectin took 72–144



hours. This implies that *C. halicacabum* inhibits *S. stercoralis* vitality effectively and may be a natural anti-parasitic agent. Despite encouraging results, more clinical testing is necessary to ascertain the drug's safety, dose, and efficacy in human subjects. Further research into the therapeutic uses of medicinal plants is necessary, as this study also shows their potential as substitutes for traditional anti-parasitic medications [22].

Anti-Cancer Activity:

The *n*-hexane extract of *C. halicacabum* showed significant cytotoxic activity against the MCF-7 breast cancer cell line, with a growth inhibition value (GI50) of 12.8 µg/ml, while the chloroform extract demonstrated stronger efficacy than the ethanolic extract. The plant's antioxidant properties were confirmed through various scavenging assays, indicating its role in mitigating oxidative stress. Additionally, the ability of *C. halicacabum* to regulate apoptotic cell necrosis caused by zinc oxide nanoparticles highlights its potential in malignancy management. These findings underscore its promising therapeutic applications, but further research is crucial to isolate active compounds and validate its clinical use [13].

Anti-Pyretic Activity:

Cardiospermum halicacabum exhibits anti-pyretic properties, with alcohol and *n*-hexane extracts showing significant efficacy against yeast-induced pyrexia in Wistar rats. At 400 mg/kg, their effects were comparable to paracetamol (100 mg/kg) within 2 hours, while aqueous extracts showed no activity. The study supports its use as a safe natural remedy for fever, warranting further investigation into its mechanisms and applications [23].

Anti-Filarial Activity:

A parasite infection spread by mosquitoes, lymphatic filariasis (LF) causes major deformities and handicap, especially in tropical and subtropical areas, by causing limbs and genitalia to enlarge (oedema) over time. The effects of *Cardiospermum halicacabum* aqueous and ethanolic extracts on adult worms and *Brugia pahangi* microfilariae were examined in vitro in this study [24]. The ethanol extract had a quick impact on microfilariae movement, and other important findings included a dose- and time-dependent decrease in microfilariae release and adult worm motility. The MTT assay also showed effects on tissue viability in seven-day-old worms. Even though its activity was lower, the aqueous extract still had direct action against *B. pahangi*. These results point to *C. halicacabum* extracts' potential as effective weapons in the battle against LF [25].

Anti-Malarial Activity:

The anti-malarial activity of *Cardiospermum halicacabum* is low; ethyl acetate extracts were lethal in mice and provided little protection against *Plasmodium berghei*, while aqueous extracts demonstrated weak in vitro efficacy against chloroquine-sensitive (D10) and resistant (K1) malaria parasites. Further research into alternate extraction techniques is necessary in light of these findings, which show discrepancies between in vitro and in vivo display screens [26].

Anti-Convulsant Activity:

Cardiospermum halicacabum alcoholic root extract's anticonvulsant properties in male Swiss albino mice employing several epileptic models. When isoniazid, pentylenetetrazol, and picrotoxin were administered orally at dosages of 30, 100, and 300 mg/kg, the start of clonus and tonus was postponed. The extract also decreased the maximal electroshock model's tonic hind limb extension.



Notably, no appreciable motor toxicity was seen even at the maximum dosage of 900 mg/kg. The cerebellum and other brain regions showed elevated GABAergic activity, according to HPLC analysis of brain monoamines, suggesting a possible basis for its anticonvulsant effects. In order to completely comprehend its therapeutic potential and underlying mechanisms, more research is necessary. These data imply that *C. halicacabum* has strong anticonvulsant qualities with little motor toxicity [27].

Anti-Ulcer Activity:

The anti-ulcer effects of *Cardiospermum halicacabum* ethanolic extract in male Wistar rats using ulcer models generated by ethanol and Indomethacin. In comparison to omeprazole (10 mg/kg/day), oral treatment of 200–600 mg/kg showed a dose-dependent decrease in gastric mucosal injury. The extract showed protective effects by reducing alkaline phosphatase activity and raising stomach glutathione levels. It also showed lipid peroxidation inhibition and hydroxyl radical scavenging, indicating antioxidant potential. Crucially, rats did not exhibit any discernible acute or short-term harm. These results show *C. halicacabum* to be a promising gastroprotective agent that merits more research into its active ingredients and potential for use in clinical settings [28].

Adulticidal Activity:

The methanolic extract of *Cardiospermum halicacabum* exhibits 100% mortality for *Culex quinquefasciatus* and ovicidal action for *Aedes aegypti*, demonstrating the extracts' potent adulticidal and repellent properties against mosquitoes [29]. These results underline the need for more study and standardized techniques while highlighting its promise as a natural mosquito control tool [30].

Anti-Hiv And Anti-Hbv Potential Of *Cardiospermum Halicacabum*:

The research on *Cardiospermum halicacabum* shows that it has considerable promise as a treatment for coinfections of HIV and HBV. Its dual efficacy was highlighted by the methanol extract's remarkable inhibition rates for HBsAg (79%) and HIV-RT (91%). A promising lead chemical for medication development, benzene dicarboxylic acid had substantial binding affinities among the 11 bioactive compounds found, with docking scores of –4.85 against HIV receptors and –4.71 against HBV receptors. The extract's efficiency is further confirmed by the anti-HBsAg activity, which was assessed over a five-day period using ELISA. This work emphasizes the value of investigating medicinal plants to fight resistant coinfections, but further molecular understanding and clinical research are required to validate their therapeutic efficacy [31].

Fertility Activity:

The fertility-enhancing properties of *Cardiospermum halicacabum* aqueous leaf extract (ALE) in male rats, administered at doses of 100 and 200 mg/kg for 30 days. ALE significantly improved sperm count and motility in both caput and cauda regions in a dose-dependent manner, accompanied by elevated serum testosterone levels. It also enhanced reproductive outcomes in females, increasing impregnation rates, implantation numbers, and viable foetuses, while reducing resorption sites. Notably, ALE exhibited no renal toxicity and showcased hepatoprotective effects, with sex organ weight and serum cholesterol levels remaining unchanged, indicating targeted efficacy. These findings establish ALE as a promising natural fertility enhancer with additional protective benefits, though further investigation in humans is essential



to confirm its safety, mechanism of action, and broader therapeutic potential [32].

MEDICINAL USES

Cardiospermum halicacabum is a multipurpose medicinal plant that has been used extensively in Ayurvedic medicine to treat a variety of illnesses [33]. Its leaves, roots, and entire herb have medicinal qualities that are useful in treating respiratory ailments like colds, asthma, and pertussis as well as diarrhoea, dysentery, and haemorrhoids [34]. The plant's diuretic qualities help with renal problems like nephritis and urinary tract infections, and its anti-inflammatory and wound-healing qualities help with eczema, ulcers, and itching [35]. The plant's ability to treat disorders of the central nervous system is demonstrated by its calming and anti-spasmodic properties [36]. Its aqueous and ethanolic extracts have antibacterial, antifeedant, and insect-resistant properties, and its seed oil adds even more value [37]. Poultices or decoctions can also be used to treat swellings, bladder catarrh, and earaches. The results support its conventional uses and highlight its potential for contemporary pharmacological study. It is a priceless tool in natural therapy because of its remarkable adaptability [38].

CONCLUSION

Cardiospermum halicacabum has an accomplished deal of curative implicit and is used to treat everything from simple ails to long-term conditions. In India, it's frequently eaten as a lush vegetable and is an uncultivated crop. It has a variety of phytochemical factors that contribute to its medicinal effectiveness. Its multitudinous pharmacological conduct *in vitro* has been scientifically demonstrated. likewise, it has been suggested that the factory *C. halicacabum* be used as a supereminent chemical in the creation of an affordable and safe medicine. In order to prize,

identify, and assess the nature of bioactive composites and their beginning mechanisms for the development of artificial Medicinal's, further information is demanded, indeed though studies have demonstrated a correlation between conditioning and the active factors present. Numerous studies have demonstrated the factory's anti-inflammatory, antioxidant, anti-microbial, anti-fungal, anti-diabetic, anti-sickling, anti-arthritis, anti-diarrheal, anti-parasitic, anti-cancer, anti-pyretic, anti-filarial, anti-malarial, anti-convulsant, anti-ulcer, anti-HIV, anti-HBV, adulticidal exertion, and fertility rates. As a major source of phytochemical factors, similar as phenols, steroids, tannins, saponins, terpenoids, and flavonoids, the findings supported its traditional use for mortal affections and handed an explanation for its use in herbal drug. Accordingly, it's possible to use this factory in place of specifics. This review highlights this factory's eventuality for bioactivity, which could be profitable to society.

ACKNOWLEDGEMENT

We express our deepest gratitude to our guide Dr. Aparna Baliwada M. Pharm, Ph D, for her invaluable mentorship, constructive feedback, and unwavering support throughout the preparation of this review article. Their expertise and encouragement were instrumental in shaping our work and ensuring its quality.

REFERENCES

1. Azamthulla M, Shree M. A review of *Cardiospermum halicacabum* (Sapindaceae). World J Pharm Pharm. Sci. 2019; 8:410.
2. Researchgate.net. [cited 2025 Apr 24]. Available from: https://www.researchgate.net/publication/371601848_A_Comprehensive_Review_on_Cardiospermum_halicacabum



3. Murti K, Panchall MA, Lambole V, Gajera V. Pharmacological properties of *Cardiospermum halicacabum*—A review. *Sect Title Pharmacol.* 2010; 1009:1005-9.
4. Mohaddesi B, Chauhan M. Pharmacognostical and physico-chemical evaluations of *Cardiospermum halicacabum* L Seeds. 2016; 3:35-41.
5. Sarvanandaa L, Premarathna AD, Karunarathnad SC. Immunomodulatory effect of *Cardiospermum halicacabum* against cancer. *Biomed J Sci Tech Res.* 2018; 10:1-4. <https://doi.org/10.26717/BJSTR.2018.10.001976> DOI: <https://doi.org/10.26717/BJSTR.2018.10.001976>
6. Raza A. Review of beneficial and remedial aspects of *Cardiospermum halicacabum* L. *African J Pharm Pharmacol.* 2013; 7:3026-33. <https://doi.org/10.5897/AJPP2013.3719> DOI: <https://doi.org/10.5897/AJPP2013.3719>
7. Abdullah SS, Kumar MA, Kumar SB, Anand AV, Krishnamurthy T. Assessment of phytoconstituents, nutrients and antibacterial activity of *Cardiospermum halicacabum* Linn. *Biosci Biotechnol Res Asia.* 2008; 5:811-14.
8. Ferrara L. *Cardiospermum halicacabum* Linn.: Food and Drug. *Int J Med Rev.* 2018; 5:146-50. <https://doi.org/10.29252/IJMR-050404> DOI: <https://doi.org/10.29252/IJMR-050404>
9. Danlami U, Adebisi FA, David BM, Lawal DR, K. M. G. *Asian J Pharm Biol Res.* 2013:34-5.
10. Azab A, Nassar A, Azab AN. Anti-inflammatory activity of natural products. *Molecules.* 2016; 21:1-19. <https://doi.org/10.3390/molecules21101321> DOI: <https://doi.org/10.3390/molecules21101321>
11. Huang M-H, Huang S-S, Wang B-S, Wu S-H, Sheu M-J, Hou W-C, et al. Antioxidant and anti-inflammatory properties of *Cardiospermum halicacabum* and its reference compounds ex vivo and in vivo. *J Ethnopharmacol.* 2011; 133:743-50. <https://doi.org/10.1016/j.jep.2010.11.005> DOI: <https://doi.org/10.1016/j.jep.2010.11.005>
12. Kumaran A, Karunakaran RJ. Antioxidant activities of the methanol extract of *Cardiospermum halicacabum*. *Pharm Biol.* 2006; 44:146-51. <https://doi.org/10.1080/13880200600596302> DOI: <https://doi.org/10.1080/13880200600596302>
13. Aishwarya V, Abdulla SS, Dheebe B, Renuka R. In vitro antioxidant and anticancer activity of *Cardiospermum halicacabum* L. Against each cell line. *Int J Pharm Pharm Sci.* 2014; 6:263-8.
14. Vaghasiya J, Malaviya S, Nandakumar K, Bhalodiya YS. Anxiolytic activity of root extracts of *Cardiospermum halicacabum* in mice. *Materials and Methods.* 2009. <https://doi.org/10.5580/1e23> DOI: <https://doi.org/10.5580/1e23>
15. Researchgate.net. [cited 2025 Apr 25]. Available from: https://www.researchgate.net/publication/333680906_A_REVIEW_OF_CARDIOSPERMUM_HALICACABUM_SAPINDACEAE
16. Jeyadevi R, Sivasudha T, Ilavarasi A, Thajuddin N. Chemical constituents and antimicrobial activity of Indian green leafy vegetable *Cardiospermum halicacabum*. *Indian J Microbiol.* 2013; 53:208-13. <https://doi.org/10.1007/s12088-012-0333-4> DOI: <https://doi.org/10.1007/s12088-012-0333-4>
17. Gaziano R, Campione E, Iacovelli F, Marino D, Pica F, Di Francesco P, et al. Antifungal activity of *Cardiospermum halicacabum* L. (Sapindaceae) against trichophyton rubrum occurs through molecular interaction with

- fungus Hsp90. Drug Des Devel Ther. 2018; 12:2185-93.
<https://doi.org/10.2147/DDDT.S155610> DOI: <https://doi.org/10.2147/DDDT.S155610>
18. Stalin C, Vivekanandan K, Bhavya E. Leaves extracts in vitro antidiabetic activity of *Cardiospermum*. 2013; 13.
19. Gurib-Fakim A, Sewraj MD. Studies on the antisickling properties of extracts of *Sideroxylon puberulum*, *Faujasia flexuosa*, *Cardiospermum halicacabum*, and *Pelargonium graveolens*. *Planta Med*. 1992; 58. <https://doi.org/10.1055/s-2006-961657> DOI: <https://doi.org/10.1055/s-2006-961657>
20. Kumar E, Mastan SK, Sreekanth N, Chaitanya G, Reddy GA, Raghunandan N. Anti-arthritis property of the ethanolic leaf extract of *Cardiospermum halicacabum* Linn. *Biomed Pharmacol J*. 2008; 1:395-400.
21. Prakash KC, Kuppast IJ. Anti-diarrhoeal activity of *Cardiospermum halicacabum* and *Dodonaea viscosa*. *Int J Pharm Pharm Sci*. 2014; 6:6-10.
22. Boonmars T, Khunkitti W, Sithithaworn P, Fujimaki Y. In vitro antiparasitic activity of extracts of *Cardiospermum halicacabum* against third-stage larvae of *Strongyloides stercoralis*. *Parasitol Res*. 2005; 97:417-19. <https://doi.org/10.1007/s00436-005-1470-z> DOI: <https://doi.org/10.1007/s00436-005-1470-z>
23. Pushpangadan P, Garden B. Antipyretic activity of *Cardiospermum halicacabum*. *Indian J Exp Biol*. 1999; 37:411-14.
24. Dickson BFR, Graves PM, Aye NN, Nwe TW, Wai T, Win SS, et al. The prevalence of lymphatic filariasis infection and disease following six rounds of mass drug administration in Mandalay Region, Myanmar. *PLoS Negl. Trop Dis*. 2018; 12. <https://doi.org/10.1371/journal.pntd.0006944> DOI: <https://doi.org/10.1371/journal.pntd.0006944>
25. Khunkitti W, Fujimaki Y, Aoki Y. In vitro antifilarial activity of extracts of the medicinal plant *Cardiospermum halicacabum* against *Brugia pahangi*. *J Helminthol*. 2000; 74:241-6. <https://doi.org/10.1017/S0022149X00000342> DOI: <https://doi.org/10.1017/S0022149X00000342>
26. Waako PJ, Gumedde B, Smith P, Folb PI. The in vitro and in vivo antimalarial activity of *Cardiospermum halicacabum* L. and *Momordica foetida* Schumch. *Et Thonn. J Ethnopharmacol*. 2005; 99:137-43. <https://doi.org/10.1016/j.jep.2005.02.017> DOI: <https://doi.org/10.1016/j.jep.2005.02.017>
27. Dhayabaran D, Florance J. Anticonvulsant activity of alcoholic root extract of *Cardiospermum halicacabum*. *Rev Bras Farmacogn*. 2012; 22(3):623-29. <https://doi.org/10.1590/S0102695X2012005000017> DOI: <https://doi.org/10.1590/S0102-695X2012005000017>
28. Vijayakumari K, Senthilkumar S. Evaluation of anti-ulcer property of *Cardiospermum halicacabum* Linn. *Int J Recent Sci Res*. 2017; 8:21617-20.
29. Govindarajan M, Sivakumar R. Repellent properties of *Cardiospermum halicacabum* Linn. (Family: Sapindaceae) plant leaf extracts against three important vector mosquitoes. *Asian Pac J Trop Biomed*. 2012; 2:602-7. [https://doi.org/10.1016/S2221-1691\(12\)60105-1](https://doi.org/10.1016/S2221-1691(12)60105-1) DOI: [https://doi.org/10.1016/S2221-1691\(12\)60105-1](https://doi.org/10.1016/S2221-1691(12)60105-1)
30. Govindarajan M, Sivakumar R. Adulticidal properties of *Cardiospermum halicacabum* plant extracts against three important vector mosquitoes. *Eur Rev Med Pharmacol Sci*. 2012; 16:95-104.

31. Murugan K, Prabu RV, Sangeetha S, Al-Sohaibani S. Antiviral activity of *Cardiospermum halicacabum* L. extract against coinfecting agents HIV and HBV. *J Herbs Spices Med Plants*. 2011; 17:403-18...
<https://doi.org/10.1080/10496475.2011.605515> DOI:
<https://doi.org/10.1080/10496475.2011.605515>
32. Peiris LDC, Dhanushka MAT, Jayathilake TAHDG. Evaluation of aqueous leaf extract of *Cardiospermum halicacabum* (L.) on fertility of male rats. *Biomed Res Int*. 2015; (2015).
<https://doi.org/10.1155/2015/175726> DOI:
<https://doi.org/10.1155/2015/175726>
33. Dixena D, Patel DK. Morphology and medicinal values of *Cardiospermum halicacabum*. *Flora Fauna*. 2019; 25:167-76..
<https://doi.org/10.33451/florafauna.v25i2pp167-176> DOI:
<https://doi.org/10.33451/florafauna.v25i2pp167-176>
34. Jain S, Srivastava S. Traditional uses of some Indian plants among islanders of the Indian Ocean. *Indian J Tradit Knowl*. 2005; 4:345-57.
35. Shakunthala B, Sambuddha, G, Shobha D, Shruthi SD. Medicinal importance of plants used for treating rheumatoid arthritis in Dakshina Kannada, Karnataka, India. 2021; 1(1):28-51.
36. Pillai NR, Vijayamma N. Some pharmacological studies on *Cardiospermum halicacabum* Linn. *Anc Sci Life*. 1985; 5:32-6.
37. Vadivazhagi MK. Anti-oxidation and anti-microbial efficiency of *Cardiospermum halicacabum* leaf. *XIII*, 834-47.
38. Review, L. A., N, T. S., Yr, S. K., Anand, M., Kg, V. K. *World Journal of Pharmaceutical research* Ethnomedicinal value of *Cardiospermum halicacabum*. 2013; 2:3348-55.

HOW TO CITE: Dr. Aparna Baliwada*, Akshitha Pothu, Keerthana Puligilla, Rakesh Mudavath, Dr. G. Tulja Rani, A Review on Phytochemical and Pharmacological Investigation of *Cardiospermum Halicacabum* L (Sapindaceae), *Int. J. of Pharm. Sci.*, 2025, Vol 3, Issue 6, 2710-2722. <https://doi.org/10.5281/zenodo.15677304>

