



Cardiospermum halicacabum Linn. - A Review of its Medicinal Effects on Human Healthcare System

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Authors' contributions

This work was carried out in collaboration between both authors. Author NV designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author KSK managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

A current revision based on medicinal effects on the human healthcare system regarding *Cardiospermum halicacabum* Linn. herb comes under the family Sapindaceae and frequently known as Balloon vine. It can be seen in tropical and subtropical areas mostly. Mainly used for rheumatism treatment for several centuries. Other than rheumatism treatment, it is widely used to treat snakebite and stiffness of limbs. Ayurvedic form of medicine and folk form of medicine was prepared from this herb and also widely used. From various parts especially the root, stem, leaves, and seed of this herb contains plenty of bioactive compounds and widely used as food and medicine to cure lots of disorders. Ethanolic extract and alcoholic extract of various part of this herb are used for many pharmacological activities like antibacterial and anti-biofilm properties, to treat ethanol induce gastric ulcer in rats, protective role against STZ induced diabetic rats, and fertility of male rats using leaf extract, the antiparasitic activity of extract using in vivo method, antioxidant and anti-inflammatory properties by ex vivo and in vivo method, etc. Different evaluation of this herb is done for controlled toxicity and deterioration regarding quality to ensure safety for the usage of this herb in the form of medicines can be taken into consideration for upcoming researchers to develop and apply different methods based on the separation of bioactive compounds for the treatment of different disorders.

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1. INTRODUCTION

Plant-based drugs had been globally used for different illness healing in conventional medicinal systems. 80% of around world population depends on medicinal plants still for their health care urgency primarily where medicines are not likely accessible. Bio-friendly and eco-friendly plant-based commodities have been considered for recent prevention and treatment of different types of infections in humans along with microbial diseases all over the world and plant recruitment in ethnomedicine besides progresses worldwide. Nature has gifted on us with plenty of botanical wealth and has a huge number of distinct varieties of plants grow in various parts of the country [1-4].

India is abundant in all three plains of biodiversity as species diversity, habitat diversity, and genetic diversity. Around 75-80% of the world population, Herbal medicine is widely used still in developing countries. The plants have various active biomolecules and phytochemicals, which play a significant role in the ailment of threatening diseases. Several herbal plants had been elucidated to identify effective new compounds and their mechanism to prevent many diseases. In India, there are thousands of known species have medicinal value and use of different parts of many medicinal plants to cure specific disease have been in vogue till ancient times and *Cardiospermum halicacabum* Linn. belongs to family Sapindaceae is one among such plant which broadly used by traditional practitioners to treat various ailments. *Cardiospermum* is derived in Latin terms cardio means heart and sperm means seed and it referred to a white heart-shaped seed as well as *halicacabum* is also derived from Latin terms *halicacabus* means a plant with inflated fruits. It is a tiny delicate, thinner, climber and the whole plant that has been used for many centuries to treat many diseased conditions [5].

2. GEOGRAPHY

Cardiospermum halicacabum Linn. herb broadly distributed in Asia, America and Africa and seen along the roads and rivers. This herb mostly found in waste ground and moist soils and seasonal climates and marshy flooded places is the best ecological conditions. The flowering blooms and seed ripening seasons are from July to october [6,7].

3. PHARMACOGNOSTICAL CHARACTERISTICS

According to pharmacognostical character, *Cardiospermum halicacabum* Linn. is the botanical name of the herb and also known in the name of heart pea, balloon vine, love in a puff commonly. *Cardiospermum glabrum* *Cardiospermum corundum* L., and *Cardiospermum inflatum* are the synonyms of this herb and belongs to Sapindaceae family. The herb is glabrous with sparingly hairy stem, ridged stalk of a leaf with tiny stipules at the base and leaflets are lobed pinnately along with narrowed stalks [7].

Flowers are tiny white in colour with straight pedicel. Fruits are branched pyriform. Seeds are black in colour with a big white heart aril. There are 4 Sepals generally ovate, imbricate, green, red shade with white boundaries and almost hairless and 4 Petals having inside scale base, white to cream with yellowish edge and without approximate hair. The higher ovary is 3-celled and 3-angled, with 1 ovule per cell. This possesses 3 carpals, 3 stigmas, and ovules with axial placentation are present. The fruit is a inflate, 3-lobed, spherical casing, and 3-celled. The base is papery, green but reddish or with reddish veins. Herb contains almost 16 species present in Brazil and 12 species among them are found in South America. This plant exhibits a different number of chromosomes with metacentric and submetacentric chromosomes and has subtelo-centric chromosomes, but lacking in telocentric chromosomes. The roots, seeds, and leaves of the herb are utilized as herbal medication [7-10].

The *Cardiospermum halicacabum* Linn. has undergone a microscopic evaluation of dried leaves which indicates the presence of rosette crystals and acicular crystals of calcium oxalate. It is needle-like, slender, long pointed ends in acicular crystals along with clusters, fragmented oil cells were observed. And numerous trichomes are seen in dried powders. Glandular trichomes were observed along with simple, warty, long, unicellular trichomes with one-celled stalk, pointed ends and bulbous base. Parenchyma cells contain mucilage has been observed. Sclerenchyma tissue was observed whose cells appeared polygonal shape with thickened, stratified walls and without intercellular spaces.

The plant powder also indicates the presence of xylem vessels with a spiral thickening [11].

The physicochemical parameters of a whole dried plant of *Cardiospermum halicacabum* Linn. observed the Moisture content $4.08 \pm 0.34\%$, Alcohol soluble extractive $13.4 \pm 0.33\%$, Water soluble extractive $10.2 \pm 0.23\%$, total ash $7.26 \pm 0.53\%$, Water soluble ash $4.80 \pm 0.04\%$, acid insoluble ash $1.11 \pm 0.17\%$, and loss on drying $6.73 \pm 0.21\%$ [11].

Phytochemical Screening has qualitatively indicated the presence of flavones, triterpenoids, glycosides, aglycones, fatty acids, and volatile esters. Other secondary metabolites reported include carbohydrates, alkaloids, proteins, saponins, steroids, lignin, cardiac glycosides found in little quantities in extracts [12-13].

4. PHARMACOLOGICAL ACTIVITY OF CARDIOSPERMUM HALICACABUM

4.1 Antibacterial Activity and Antibiofilm Activity

Microbial infections are an important health problem throughout the world and plants are possible sources of antimicrobial agents. The excited to figure out plants retaining antibacterial activity for different ailments is growing. In common, Plant-based antibacterial has a huge remedial capability as they can aid the resolve with minor side effects that are generally with synthetic antibacterial effect. Antibacterial activity of *Cardiospermum halicacabum* is carried out by the In vitro agar disc diffusion method. Among this *Bacillus subtilis* and *Staphylococcus aureus* revealed the high zone of inhibition activity and also revealed minor activity against the control (Ampicillin). Biomedical application aptitude of this activity is assured by synthesized green nanoparticles. It is confirmed that the methanol extract of the stem might be an acceptable antibacterial source [14-17].

4.2 In-Vitro Antidiabetic Activity

The study had been initiated to examine the glucose uptake of crude n-hexane, methanol, ethanol and aqueous leaf extracts by In-Vitro antidiabetic activity of *Cardiospermum halicacabum*. This plant leaf extract has been subjected to the inhibitory effect of the utilization of glucose using in vitro standard procedure. Among the different leaf extracts, it has been revealed that the methanolic leaf extract at a dose of 50g plant leaf extract is found to be

effective than other extracts with the lowest concentration of glucose at the end stage of 27 hrs. The conclusion denotes that, the methanolic leaf extract reveals the significant inhibitory effect on the diffusion of glucose by in vitro methods thus validating the remedial justify of the plant [18].

4.3 Protective Effect on Potassium Dichromate Induced Nephrotoxicity in Rats

Somasekhar Reddy et al., were been intended to examine the protective effect of this plant against potassium dichromate persuade nephrotoxicity in rats. Potassium dichromate which is a chemical compound broadly used in chrome plating, metallurgy, chemical industry, wood preservation, textile manufacture, photography, refractory, cooling systems, and stain-less steel industries. Potassium dichromate is an utmost toxic form of Chromium (VI) and has been examined to persuade nephrotoxicity related along with oxidative stress in both humans and animals. This has been examined by assaying oxidative stress biomarkers, kidney toxicity markers, lipid peroxidation and histopathological determination of kidney. A toxic effect induced by Potassium dichromate is prevented by pretreatment within a protective mechanism that involved oxidative stress reduction and by histopathological restoration change against the administration of Potassium dichromate. As a result, it indicates that the methanol extract of *Cardiospermum halicacabum* stem revealed that the protective effect against potassium dichromate induced nephrotoxicity [18-19].

4.4 Anti-Arthritic Activity

The effect on anti-arthritic activity by ethanolic extract of plant leaves given by oral administration at a concentration of 125 mg/kg and 250 mg/kg on Freund's complete adjuvant constrained arthritis had been studied in rats. The treatment possessed by measuring the volume of a paw and various hematological parameters is used like hemoglobin content, red blood cell count, white blood cell count, and erythrocyte sedimentation rate. The elucidated result indicates that the extract inhibited the Freund's complete adjuvant-induced arthritis in a concentration-dependent manner effective with 250 mg/kg dose. The report was compared with Indomethacin and results revealed that the ethanolic extract of plant leaves significantly exhibits an anti-arthritic effect [20-21].

4.5 Anticonvulsant Activity of Alcoholic Root Extract of *Cardiospermum Halicacabum*

To evaluate the anticonvulsant effects, on the various murine epilepsy models, the plant root extract has been administered p.o. to swiss albino male mice at a concentration of 30, 100 and 300 mg/kg earlier estimation. The monoamine levels of the brain had been evaluated after administration for two days. The alcoholic root extract is taken at a concentration of 100 and 300 mg/kg particularly denied the outset of clonus and tonus in Isoniazid, Pentylentetrazol and Picrotoxin-induced convulsions. The motor toxicity is detected with no significant change occur even at a raised concentration administered, i.e. 900 mg/kg. By the HPLC method, the monoamine level of brain analysis showed a GABAergic activity in C+ (in the cerebellum) and C- (except cerebellum) increases significantly. The conclusion reveals that the alcoholic root extract obtained an anticonvulsant activity significantly with a decreased motor toxicity profile. Thus, the activity that occurred maybe refer to increased GABAergic activity [22-23].

4.6 Anxiolytic Activity

Alcoholic and aqueous plant root extracts possess an effect on antianxiety in mice were studied. Before 1 hour from various anxiety activity, the mice are treated with alcoholic or aqueous plant root extract. Anti-anxiety activity is elucidated by the light-dark model (LDM), elevated plus maze (EPM) and open field test (OFT). In the elevated plus-maze, treatment with root extract showed an increase in time spent with open arm and total locomotion time. In the light-dark model, treatment with root extracts increased in time spent in light compartment and in the Open field test, treatment with these root extract showed an increase in time spent in the central compartment. This report reveals that alcoholic and aqueous plant root extracts of *Cardiospermum halicacabum* Linn. possess antianxiety activity [24].

4.7 Antioxidant Activity

Fresh and dried plant materials were elucidated for antioxidant activity using 1, 1-diphenylpicrylhydrazyl, Total phenol content and Ferric Reducing Antioxidant Power methods indicates a decreased antioxidant property for

microwave treated with plant material compared to drying treatments. 1, the 1-diphenylpicrylhydrazyl radical scavenging effect has been detected in the methanolic plant extract of microwave treated samples. The increased total phenol content has reported with fresh plant material extract with distilled boiled water. A free radical scavenging activity in plant material reveals that it had been a great potent Antioxidant activity [25].

4.8 Fertility Activity

The treatment with aqueous plant leaf extract (ALE) for 30 days produced a concentration-dependent were there is increased in sperm counts as well as increased sperm motility in cauda and caput regions. Also, there is an increased level of serum testosterone were apparent at all applied doses. Further, no necessary changes occur in sex organs weight are observed. Aqueous plant leaf extract also raised the female's impregnated number, implantation number, and viable fetuses number while lowered the total number of resorption sites of pregnant females. However, serum level in total cholesterol remained unchanged and there were Moreno-toxicity records; yet ALE presented a hepatoprotective effect. It was confirmed that aqueous plant leaf extract increased sperm count, motility, and testosterone which to results in positive fertility [26].

4.9 Antimalarial Activity

The Ethyl acetate plant extracts indicate confined in vitro method antimalarial activity, not enough to ensure further investigation. The plant extracts indicate related activity against the chloroquine and chloroquine-sensitive D10 and sulphamide resistant K1 parasites [27].

4.10 Antiulcer Activity

The Ethanolic extract of the plant shows a dose-dependent manner (200–600 mg/kg) constrained gastric ulcers analyzed by oral administration with absolute Ethanol. Again, this plant extract is administered to rats showed an increased gastric glutathione level and decreased alkaline phosphatase activity. The plant extract also constrained effective in vitro hydroxyl ion scavenging and lipid peroxidation inhibition activities. The plant extract is established to be lacking any conspicuous short-term and acute toxicity in rats [28].

4.11 The Anti-Osteoporotic Activity of Ethanolic Extract of *Cardiospermum Halicacabum* (Eech)

Ethanolic extract of this herb is compared to OVX control group that there is an improvement dependent dose in biochemical serum markers ($P < 0.0001$) higher significantly as well as a decrease in the excretion urinary profile. Anti-osteoporotic activity is experimentally observed using Zebra fish [29].

4.12 Anticancer Activity

Reports caspase 3,8 and 9 apoptotic cell necrosis stimulated by Zinc oxide nanoparticles at transcriptional stage. The apoptotic expression can be regulated down by *Cardiospermum halicacabum* and CH-ZnOPs has efficacy besides malignancy management [30].

4.13 Other Activities of the Plant

The complete plant is used for diuretic, diaphoretic, emetic, refrigerant, laxative, sudorific and stomachic. It is used to cure and prevent rheumatism, stiffness of the limbs, chronic bronchitis, and snakebite. The leaves which are rubefacient generally used to treat rheumatism. This plant is used to treat itchy skin. Used in a poultice on swellings by leaves salted. The leaf juice had been used to treat earache. The root is diuretic, diaphoretic, laxative, emmenagogue, and rubefacient. This plant is reported to possess Antiparasitic, antiulcer, antipyretic and anti filarial activity [31-37].

5. CONCLUSION

The various parts of a plant and its bioactive components have been used as either food or medicine to cure lots of diseases. Understanding the plant bioactive components and their standardizations and assess pharmacological activities like in vivo and in vitro experimentation by which drug quality, controlled toxicity, and adulterations can be disclosed in order to assure the safety and welfare of the consumer. The complex bioactive components and relatively abundant scopes of *Cardiospermum halicacabum* Linn have been taken into consideration to separate the bioactive compounds and researcher works on this plant helps to analyze its toxicological and pharmacological activities for implementing recent methodologies. The effectiveness, validity,

and safety should be figured out to treat lots of diseases. So, human society can benefit by using an herbal drug for their healthcare problems.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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