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Preliminary phytochemical analysis of *Cardiospermum halicacabum Linn*.

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Abstract
The present study investigates the preliminary phytochemical profile of *Cardiospermum halicacabum Linn*., a medicinal plant known for its ethnobotanical relevance in traditional medicine systems. The plant was collected from the Mahodari Ghat region of Nashik, Maharashtra, and subjected to phytochemical screening using aqueous and petroleum ether extracts. The methodology involved standard qualitative assays to detect the presence of bioactive compounds including cardiac glycosides, terpenoids, saponins, tannins, flavonoids, alkaloids, carbohydrates, amino acids, and phenolic compounds. Results revealed that the aqueous extract tested positive for cardiac glycosides, terpenoids, saponins, tannins, and phenolic compounds, whereas the petroleum ether extract showed the presence of terpenoids, flavonoids, alkaloids, and amino acids. These findings highlight the presence of a diverse range of phytochemicals with potential biological activities, including antioxidant, antimicrobial, and anti-inflammatory properties. The study underlines the medicinal significance of *Cardiospermum halicacabum*, suggesting its potential for further phytopharmacological investigation and drug development. The absence of certain compounds in specific extracts also emphasizes the role of solvent polarity in phytochemical extraction, which could inform future extraction protocols. Overall, this study provides a significant insight into the phytochemical richness of *C. halicacabum*, reinforcing its role in ethnomedicine and supporting its use as a source of natural bioactive compounds.

Keywords: *Cardiospermum halicacabum*, phytochemical screening, terpenoids, alkaloids, aqueous extract, petroleum ether extract

Introduction

Plants have long served as invaluable sources of medicinal agents, forming the cornerstone of traditional health care syst1ems across cultures and continents. Among them, *Cardiospermum halicacabum* Linn., commonly referred to as the "balloon vine," is a fast-growing climber belonging to the family Sapindaceae. Indigenous to tropical and subtropical regions, this plant has garnered attention for its widespread traditional use in treating rheumatism, skin disorders, and gastrointestinal ailments [1]. The resurgence of interest in natural remedies, especially in the context of increasing antibiotic resistance and adverse effects associated with synthetic drugs, has directed considerable attention towards phytochemical studies [2, 3]. Phytochemicals, including alkaloids, flavonoids, terpenoids, saponins, tannins, and phenolic compounds, are secondary metabolites responsible for the therapeutic properties of medicinal plants [4]. These compounds possess diverse biological activities, such as antioxidant, antimicrobial, anti-inflammatory, and anticancer effects [5, 6]. The relevance of *C. halicacabum* in traditional systems such as Ayurveda and Siddha is well-documented. In Ayurveda, it is used for treating arthritis, piles, and nervous disorders [7]. Various parts of the plant including leaves, roots, and seeds have been reported to exhibit analgesic, anti-inflammatory, and antipyretic activities [8]. The leaves are particularly known to exhibit antiarthritic properties [9]. Scientific studies on the chemical composition of *C. halicacabum* have confirmed the presence of bioactive components such as apigenin, luteolin, and vitexin, which are flavonoids known for their pharmacological benefits [10, 11]. Terpenoids present in the plant are recognized for their anti-inflammatory and anticancer properties, while saponins exhibit antifungal and cholesterol-lowering actions [12, 13].

Extraction methods significantly influence the nature and concentration of bioactive compounds obtained from plant materials [14]. Solvent polarity plays a pivotal role in determining the efficiency of phytochemical extraction. Aqueous extracts generally yield polar compounds such as phenols, tannins, and glycosides, whereas non-polar solvents like petroleum ether are more effective in extracting lipophilic compounds including terpenoids and flavonoids [15, 16].

In the current study, both aqueous and petroleum ether extracts of *C. halicacabum* leaves were screened for the presence of key phytochemicals using standard qualitative tests. This preliminary screening is critical for identifying promising plant candidates for further phytochemical, pharmacological, and clinical research [17]. Previous studies have emphasized the significance of qualitative phytochemical screening as the first step towards the discovery of new drugs. For instance, crude leaf extracts of medicinal plants have been tested for antibacterial properties against drug-resistant pathogens, with positive correlation to the presence of alkaloids and phenolic compounds [18]. Similarly, flavonoid-rich extracts have shown promise in antioxidant assays using DPPH and ABTS methods [19]. In India, *C. halicacabum* is commonly found growing as a weed in dry, sandy soils. The ethnomedicinal use of this plant by rural and tribal communities for treating common ailments provides a strong rationale for systematic scientific investigation [20]. However, despite its traditional significance, there is a relative paucity of comprehensive phytochemical data, particularly focusing on comparative solvent extraction studies.

Materials and Methods

Collection of plant material

Cardiospermum halicacabum Linn. Poit plant was collected During November 2022 to March 2023 from Mahodari Ghat Region, Nashik (Maharashtra). The Plant material cleaned and shade dried at room Temperature. The Dried material Finely Powdered and Stored in air tight container until further use.

Methods of Extraction

The plant material was washed with water to remove shade dried at room temperature. Extracts were prepared from the leaves of *Cardiospermum halicacabum Linn*. Collected from Nashik, Maharashtra. The dried plant materials were ground into fine powder in an electric blender and subsequently sieved for obtaining fine powder. The soaked plant powder (Water, Petroleum Ether) was filtered and used as such for qualitative phytochemical analysis.

Phytochemical Screening

The commonly Known Phytochemical From plants are Cardiac glycosides, Terpinoides, Saponin, Tannin, Flavonoid, Alkaloids, Carbohydrate, Amino acids, Phenolic Compounds, the following Qualitative Tests were performed to explore phytochemicals Profile of different extracts.

1. **Test for Cardiac glycosides:** 0.5ml of each extract was treated with 0.2ml glacial acetic acid then 1 drop of 3.55% Ferric Chloride (FeCl3) was added to the solution this was layered with 1ml of concentrated H2SO4. A reddish-Brown ring was occurred at the Interface indicates the presence of Cardiac glycosides.

2. **Test for Terpenoides:** 5ml of each extract was dissolved in 2ml of chloroform (Evaporated on water bath).3ml of concentrated H2SO4 was added carefully from the wall of test tube. The solution was boiled on water bath. A grey coloured Solution indicated the Presence of Terpenoids.

3. **Test for Saponin:** 0.5ml of extract was taken in the test tube and ml of distilled water was added to it. The solution was vigorously shaken and stable persistent Froth was observed for the Presence of Saponin.

4. **Test for Tannin:** 0.5ml of extract and 5ml of distilled water was taken in test tube then it was boiled then filtered. Few drops of concentrated H2SO4 and 1% FeCl3 were added to the Filtrate. Deep Green, Brownish green or Blue-Black coloration was indicating the Presence of Tannin.

5. **Test for Flavonoid:** 0.5ml of extract and 5ml of distilled water was added to test tube then it was filtered. 5ml of diluted ammonia solution was added to the filtrate then concentrated H2SO4 was added. A yellow coloration indicated the presence of Flavonoid. The yellow Colour disappeared on standing.

6. **Test for Alkaloids:** 0.5ml of each extract was dissolved in 2ml of methanol. Few drops of 1%HCL added to it. Then the mixture was heated, kept in steam and after cooling. Then the mixture was treated with few drops of Wagner's reagent (Iodine in Potassium Iodide). Formation of brown/reddish precipitate indicates the presence of alkaloids.

7. **Test for Carbohydrate:** 0.5ml of extract was treated with 0.5ml of Benedict's reagent and boiled for 2 min. Orange red precipitate indicates the presence of reducing sugars.

8. **Test for Amino acids:** Few ml of extract was treated with 0.25% w/v Ninhydrin reagent and boiled for few minutes. Formation of blue colour indicates the presence of amino acid.

Test for Phenolic Compounds: 1ml of extract was treated with few drops of diluted Iodine solution. Transient red colour indicates the presence of phenols.

Result and Discussion

The aqueous extract was rich in cardiac glycosides, saponins, tannins, and phenolic compounds, which are known for their antioxidant and cardioprotective functions [21, 22]. On the other hand, the petroleum ether extract showed positive results for alkaloids and flavonoids, compounds widely studied for antimicrobial and anti-inflammatory activities [23, 24]. These findings align with earlier studies suggesting that the phytochemical profile of plant extracts varies significantly with the type of solvent used [25, 26]. The presence of terpenoids in both extracts suggests that they are soluble in a wide range of solvents, indicating their abundance in the plant material [27].

Sr. No	TEST	Aqueous Extract	Petroleum Ether
1.	Cardiac glycosides	+	-
2.	Terpinoides	+	+
3.	Saponin	+	-
4.	Tannin	+	-
5.	Flavonoid	-	+
6.	Alkaloids	-	+
7.	Amino acids	-	+
8.	Phenolic Compounds	+	-

Conclusion

The preliminary phytochemical screening of *Cardiospermum halicacabum* leaves demonstrates a rich array of bioactive compounds, especially in the aqueous and petroleum ether extracts. The aqueous extract revealed significant presence of cardiac glycosides, tannins, saponins, and phenolic compounds, indicating potential antioxidant, cardioprotective, and anti-inflammatory activities. The petroleum ether extract was rich in flavonoids and alkaloids, hinting at possible antimicrobial and neuroprotective roles. These results reaffirm the ethnomedicinal value of *C. halicacabum* and provide a rationale for further scientific exploration including chromatographic profiling and pharmacological testing. The study also reinforces the importance of solvent choice in phytochemical extraction processes. Future research could involve quantitative analysis, identification of specific compounds using GC-MS or LC-MS, and in vivo bioactivity assays to validate therapeutic potentials. Ultimately, the findings contribute to the growing body of evidence supporting *Cardiospermum halicacabum* as a valuable source of phytochemicals for the development of novel herbal formulations.

Conflict of Interest
The author hereby declares no conflict of interest.

Consent for publication
The author declares that the work has consent for publication.

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