Analysis of phytochemical constituents and antimicrobial properties of *Cardiospermum halicacabum* Linn

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**INTRODUCTION**

Although the western medicine is evidence-based and has highly trained and skilled professionals and follows many quality control procedures, the drugs show side effects, and they are very expensive for certain diseases. These factors cause migration people from modern medicine to natural medicine. Most of the drugs which are used in the natural system of medicine are plant origin. These plants remove our body toxins in nature way without harming or damaging our system.¹ Our Indian forests are the sources of plenty of herbal plants with excellent bioactive compounds which cure complicated chronic ailments.² Among the plenty of medicinal plants, very few plant species have been examined for their medicinal properties. Plant species have a rich source of many biologically active compounds, but very few plant species have been thoroughly investigate for their medicinal belongings.³⁴

*Cardiospermum halicacabum* Linn has a variety of phytocompounds and active biomolecules which plays key role in the treatment of many chronic and acute diseases such as cancer, arthritis, and other inflammatory conditions.⁵⁻⁷ *C. halicacabum* Linn belongs to the family of Sapindaceae. Common name of this plant is *Balloon vine* or *Love in a puff*, Tamil name is *Mudakkathan*. *C. halicacabum* is derived from the Latin word. Cardio means heart and sperm means seed. Hence, *Cardiospermum* refers to the white heart-shaped pattern of the seed. *Halicacabum* is derived from halicacabus which means a plant with inflated fruits.⁹

This plant has 16 species which are distributed in tropical and subtropical areas of Africa and Asia. It is an annual or sometimes perennial climber and which is pubertal or glabrous. Stems are minutely puberulous or slightly woody, tendrils present. Bitternates types of leaves have 3-foliolate with each part divided again into 3 leaflets which have coarse serrate teeth. Flowers are white with yellowish center. Fruits are green in color, membranous, and inflated capsule. Fruits

**ABSTRACT**

**Background:** Nowadays, natural remedies play an important role in the medicinal field. Medicinal plants are the potential source of medicinal substances. An enormous number of plant species has significant therapeutic value, and they are used by us to cure many disease conditions. **Objectives:** The objectives of the present study were to analyze bioactive constituents, and antimicrobial properties of aerial parts extract of *Cardiospermum halicacabum* Linn. **Materials and Methods:** The phytochemical compounds of *C. halicacabum* extract was evaluated by qualitative method and antimicrobial properties were screened against *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Streptococcus mutans*, and *Candida albicans* by agar well diffusion method. **Results:** The phytochemical screening of the extract indicated the presence of carbohydrates, protein, glycosides, flavonoids, saponins, alkaloids, and tannins. This extract showed the significant antimicrobial activity against microorganisms tested. **Conclusion:** The traditional medicinal plant - *C. halicacabum* Linn possessed effective antimicrobial activity against human pathogens due to the existence of bioactive phytochemical compounds.

**KEY WORDS:** *Cardiospermum halicacabum*, Phytochemical analysis, Antimicrobial activity

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are >2 cm long. Seeds are round and black in color which has a heart-shaped spot.⁹

Due to the presence of various bioactive compounds, this plant has antibacterial, antifungal, antiparasitic, antidiarrheal, anxiolytic, antioxidant, antipyretic, antirheumatic, anticonvulsant, anti-inflammatory, and anticarcinogenic activities.⁹,¹⁰

Hence, the aim of the current study was to analyze the phytocompounds which are present in *C. halicacabum* Linn and antimicrobial property against *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Streptococcus mutans*, and *Candida albicans*.

**MATERIALS AND METHODS**

Dried powdered form of aerial parts of *C. halicacabum* extract was obtained from Mr. R. Rajendren, MD of GREEN CHEM, Bengaluru.

The *C. halicacabum* extract was analyzed systematically to identify the phytochemicals such as reducing sugars, protein, glycosides, flavonoids, saponins, alkaloids, tannins, volatile acids, and terpenoids.

**Analysis of Phytochemicals**

The aerial parts extract of *C. halicacabum* Linn was analyzed by the following methods.³,⁴,¹¹

**Fehling’s Test for Carbohydrates**

With 500 µl of plant extract, 1 ml of water and 5–8 drops of Fehling’s solution were added and heated. Brick red precipitate was observed which indicates the presence of reducing sugars.

**Froth Test for Saponins**

Along with 1 g of plant extract, 10 ml of distilled water was added and boiled for 5 min. Then it is filtered. Next, in a test tube, 2.5 ml of filtrate was added with 10 ml of distilled water and shaken vigorously for 30 s. Then, it was allowed to stand for 30 min. Honeycomb froth was observed which indicates the presence of Saponins.

**Ferric Chloride Test for Tannins**

With the plant extract, distilled water, and 3–4 drops of 10% ferric chloride solution was added. Blue color was developed that indicates the presence of tannins.

**Keller-Kiliani Test for Glycosides**

In a test tube, 5 ml of plant extract was added with 2 ml of glacial acetic acid and few drops of 5% ferric chloride. Reddish brown color is observed which indicates the presence of glycosides.

**Hager’s Test for Alkaloids**

In a test tube, 2 ml of plant extract was added with picric acid. A yellowish-orange coloration was observed that indicates the presence of alkaloids.

**Ferric Chloride Test for Phenols**

In a test tube, ethanolic plant extract was taken which was added with 2 ml of freshly prepared FeCl₃ solution. Brownish green color was observed that indicates the presence of Phenolic compound.

**Lead Acetate Test for Flavonoids**

2 ml of plant extract solution was taken in test tube, and a few drops of lead acetate solution were added. Yellowish precipitate was developed that indicates the presence of flavonoids.

**Analysis for Volatile acids**

In a test tube, 2 ml of plant extract was shaken with 0.1 ml dilute NaOH and a small quantity of dilute hydrochloric acid. Appearance of white precipitate indicates the presence of volatile acids.

**Salkowski’s Test for Terpenoids**

In a test tube along with plant extract, 2 ml of chloroform was added. Then, 3 ml of concentrated sulfuric acid was added along the sides of the tube. Appearance of reddish brown color ring at the junction of the liquids indicates the presence of terpenoids.

**Millon’s Test for Proteins**

In a test tube along with 2 ml of plant extract, few drops of Millon’s reagent are added. A white precipitate was observed that indicates the presence of proteins.

**Antimicrobial Activity**

*E. coli*, *P. aeruginosa*, *S. aureus*, *S. mutans*, and *C. albicans* microorganisms were used to assess the antimicrobial property of aerial parts extraction of *C. halicacabum* Linn. The organisms were obtained from the Department of Microbiology, Saveetha Dental College and Hospitals, Chennai.

**Determination of Antimicrobial Activity**

The antimicrobial activity of the aerial part extract of the *C. halicacabum* was screened using agar well diffusion technique. Lawn culture of the bacterial strain and fungal strain adjusted to 0.5 MacFarland standard was made on Mueller-Hinton agar and SDA agar, respectively. Wells measuring 4mm depth were created using a sterile cork borer. Wells were punched and filled with plant extract. Positive and negative controls were added in the same plate. The plates were incubated at 37°C for 24 h in the incubator. After 24 h, the diameter of the zone of inhibition was measured (Vinoth et al., 2013, and Tiwari et al., 2011). The tests were done in triplicate to avoid test error.
RESULTS
The present study was done to analyze the phytochemicals which are present in the aerial parts extraction of C. halicacabum Linn. The results revealed that the extract has following the phytochemicals that carbohydrate, glycosides, alkaloids, flavonoids, saponins, tannins, and proteins Table 1.

Analysis of the antimicrobial property of ethanolic extract aerial parts of C. halicacabum Linn revealed that the extract showed varying degrees of antimicrobial activity against the following pathogens such as P. aeruginosa, E. coli, S. aureus, S. mutans, and C. albicans [Table 2].

DISCUSSION
Phytochemical analysis of the ethanolic extract of aerial parts of C. halicacabum Linn showed the presence of carbohydrate, glycosides, alkaloids, flavonoids, saponins, tannins, and proteins which are the active biocompounds[12-14] which inhibits the growth of many microorganisms by complex with the cell wall of microorganisms or binds to the adhesions and thus inhibits release of autacoids and prostaglandins, inhibits contractions caused by spasmogens, stimulates normalization of the deranged water transport across the mucosal cells, inhibits gastrointestinal release of acetylcholine. Due to these, this extract showed the antimicrobial, antihelminthic, and antidiarrheal activities.[15-17]

The ethanolic extract of aerial parts of the C. halicacabum Linn showed a significant zone of inhibition against all tested microorganisms such as P. aeruginosa, E. coli, S. aureus, S. mutans, and C. albicans.[18-21] This extract showed maximum activity against S. aureus and S. mutans with the zone of inhibition about 20 mm/100 µg/ml for followed by E. coli about 15 mm/100 µg/ml and P. aeruginosa about 9.6 mm/100 µg/ml. This extract also exhibited anticandidal activity against C. albicans about 19 mm/100 µg/ml. By increasing the concentration of extract increased the zone of inhibition.

Many studies showed that the phytochemical compounds of the plant have the capability to complex with the cell wall of the microorganisms and thus exhibit their antimicrobial activity.[22] The present study also supported that reports and showed the significant antimicrobial activity.

Plants are used worldwide for the treatment of many conditions from simple disease such as common cold to chronic diseases such as blood pressure, diabetes, and cardiovascular diseases. Medicinal substances from natural source produce no or minimal side effects in the human body when compared to the man-made drugs. The present study revealed that the extract of aerial parts of C. halicacabum Linn has a rich source of bioactive phytochemicals such as carbohydrate, glycosides, alkaloids, flavonoids, saponins, tannins, and proteins. Hence, it has potential antimicrobial activities against selective human pathogens such as P. aeruginosa, E. coli, S. aureus, S. mutans, and C. albicans.

CONCLUSION
Finally, it is concluded that the traditional medicinal plant - C. halicacabum Linn possessed effective antimicrobial activity against human pathogens due to the existence of bioactive phytochemical compounds. This study lent evidence for the ethnopharmacological utilization of this plant in the management of many acute and chronic infections.

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REFERENCES


