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PHARMACOGNOSTICAL STUDIES OF *CARDIOSPERMUM HALICACABUM L* LEAVES

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ABSTRACT

A member of the Sapindaceae family, Cardiospermum halicacabum L. is a climber plant that has long been employed in Ayurvedic, homeopathic, and Unani medicine due to its unique therapeutic qualities. The pharmacognostic analysis of Cardiospermum halica cabum L. leaves is the main topic of this work. According to ethnomedical data, it was used to treat a wide range of illnesses, such as rheumatoid arthritis, gastrointestinal disorders, stomachaches, body aches, backaches, fevers, lumbago, nerve diseases, demulcents, dropsy, and so forth. The morphological analysis demonstrated that general characteristics adhered to the family. The leaf's characteristic vascular bundle, ranunculaceous stomata, non-glandular, glandular simple, unicellular or multicellular, unbranched uniseriate trichomes on the upper and lower epidermis, and other features were revealed by detailed microscopical analysis. A cluster of angular collenchyma cells can be seen in the inner region of the adaxial cone, while sclerenchyma cells can be found in the inner region of the abaxial cone. The petiole has two noticeable grooves on the upper side, while the epidermis on the bottom side is made up of a single layer of cells. The following were determined and presented: powder microscopy, microscopic schedules, stomatal number and index, vein islet and vein termination number, palisade ratio, and physicochemical parameters including ash values, extractive values, and loss on drying.

KEYWORDS: Ash value, Extractive value, Powder microscopy, Vein islet number.

INTRODUCTION

In the traditional medical system, *Cardiospermum halicacabum Linn* (Sapindaceae) is a significant medicinal plant that is referred to as karṇasphoṭa.[1] The Sapindaceae family's Cardiospermum halicacabum L. is a climber that can be annual or occasionally perennial. It is widely grown as a weed throughout India and is found in tropical and subtropical regions of the world. In Hindi, it's called karṇasphoṭa, while in English, it's called love in a puff or balloon vine. Because of its nutritional value, the entire plant of *C. halicacabum* is used in folk remedies. It is also recognized as a medicinal plant with the ability to treat a wide range of illnesses; traditional medical systems including Chinese, Indian, and Ayurvedic medicine have all used it. C. halicacabum L. is utilized in Indian medicine to treat snakebite, limb stiffness, and chronic bronchitis. In Unani medicine, the seeds are described as a tonic for treating cancer. In Chinese medicine, it has been used to cure rheumatism, lumbago, neurological disorders, and as a demulcent in orchitis and dropsy. It is sold as herbal treatments such as cream, gel, shampoo, spray, and others, and is also beneficial for dry, itchy skin and scalp.[2] Balloon vines are perennial herbaceous climbing plants that get heavily overgrown and can even get lignified at the base. It may blossom at a height of about 25 cm and reaches over 10 meters in height. The thin, deeply grooved stems range from sparsely downy to hairy bald. The petiole and pinnate leaf blades of the 5 to 6-cm long, triangular foliage leaves are arranged on the stem. The length of the rachis is 0.4 to 2 cm, while the petiole is (0.5 to) 1.5 to 3.5 cm. The terminal leaflets measure 4 to 6 cm in length, whereas the opposing leaflets measure 1 to 2 cm. Stipules are reduced to little scales that fall early. There are two 1 mm long bracts, two circularly coiled tendrils, and three to seven blooms in a zymous inflorescence on the side of a 5 to 9 cm long, sparsely downy hairy inflorescence stem. The fourfold double perianth of the zygomorphic, functionally unisexual flowers. The inner two of the four free, concave, durable sepals are oblong-ovate, 3 to 4 mm long, and glabrous, while the outer two are round, 2 mm long, and ciliate. The four obovate, white to yellowish petals are about 3 mm long. The lowest two feature two glands and huge, leaf-shaped scales, while the upper two are covered in woolly scales. There are two circles with four free stamens apiece and simple stamps in the male flowers. The anthers are about 0.5 mm long, while the compressed stamens are hairy and roughly 2 mm long. The female flowers have an oval, 2 to 3 mm long, hairy draft tube ovary that is insulated. It also has eight staminodes and a short, fluffy, hairy stylus that culminates in a three-part scar. The

noticeable, nearly spherical, membranous, broad, pear-shaped capsule fruits have a diameter of 3 to 5 cm. They start as fluffy, hairy, light green "balloons," but when they ripen, they turn brown. Within each of the three fruit chambers, there is a single seed. A big, bright heart-shaped patch on the otherwise nearly black seed is a distinguishing characteristic of each seed. The seeds are kidney-shaped, with a diameter of around 6 mm and a white, heart-shaped aril about 5 mm broad at the base.[3] Globally found in tropical and subtropical locations, *Cardiospermum halicacabum L*. is a deciduous herbaceous climber that belongs to the Sapindaceae family. For generations, the entire plant has been used to treat a variety of ailments, including rheumatism, limb stiffness, and snake bites. These plants' roots have laxative, refrigerant, emmenagogue, emetic, sudorife, and diaphoretic properties. leaves and stalks that are eaten to cure dysentery and diarrhea. This plant yields a variety of fatty acids, volatile esters, flavones, glycones, triterpenoids, and glycosides, among other phytochemical components. It has been discovered that the seed oil has insect-repelling properties and that the seeds are utilized as anticancerous.[4] Plants like *Cardiospermum halicacabum L*. have long been used as medicines. Also known as Tejovati, Kanphuti, Kapala-phodi, Heartseed, Balloon Vine, and Winter Cherry. With an average of tendril hooks, it is a herbaceous climber or a scrambling shrub that can be either annual or perennial. Additionally, the medication displayed brief. used to treat erysipelas, rheumatism, lumbago, skeletal fractures, neurological disorders, amenorrhoea, and hemorrhoids. Herbs are used in hair oils to treat alopecia, and dandruff, and to darken hair.[5] For several centuries, the whole plant has been used for the treatment of rheumatism, stiffness of limbs, snake bites, its root for nervous diseases, as a diaphoretic, diuretic, emetic, emmenagogue, laxative, refrigerant, stomachic, and sudorific; its leaves and stalks are used in the treatment of diarrhea, dysentery, and headache and as a poultice for swellings. In Sri Lanka, skeletal fractures are treated with it. Numerous C. halicacabum products, including gel, lotion, shampoo, and spray, are sold in the market. These products work well for dry, irritated scalp and skin. Numerous investigations demonstrate that C. halicacabum extract has strong anticarcinogenic properties as well.[6] In India, Cardiospermum halicacabum Linn., often known as C. halicacabum, is a popular leafy green vegetable. It belongs to the Sapindaceae family of herbaceous climbers, which is distributed over practically all of the continents and Oceania.[7] Since the beginning of time, people have used plants to treat common illnesses, and many traditional medicines are still used today to treat a variety of problems. The healthcare system for about 60% of the world's population still relies on traditional medicines. Thousands of species in India are known to have therapeutic properties, and using various sections of several medicinal plants to treat

particular illnesses has long been practiced. A significant part of modern medicine also involves medicinal plants, which are priceless natural resources that have been studied for their biological, antibacterial, and hypoglycemic properties. They are also thought to be potentially safe medications. It is commonly recognized that plant products are the source of even the most synthetic medications.[8] Humans have long used plants as medicine for a variety of illnesses, and this practice continues today with the use of plants as supplements, either directly or indirectly. Plants have been utilized to cure nearly every illness before synthetic medications were developed. Numerous research has documented the therapeutic qualities of plants, including antimicrobial, analgesic, antibacterial, anti-inflammatory, antioxidant, and anticancer effects. One of the main causes of the rise in degenerative diseases is oxidative stress. Finding natural antioxidants for therapeutic purposes and replacing synthetic antioxidants—which have been linked to cancer—has garnered a lot of attention lately. Reactive oxygen species (ROS) and oxidative stress produce widespread tissue damage that has been linked to several chronic diseases, degenerative disorders, aging, cardiovascular diseases, diabetes, Alzheimer's disease, cancer, and other conditions. Additionally, food may have unfavorable impacts from oxidative stress that render it inappropriate for human ingestion. The antioxidant and anticancer properties of phenolic acid and flavonoids, which are secondary metabolites of plants, have been extensively researched. Numerous studies demonstrate that by reducing oxidative stress, antioxidants can lower the risk of cancer, arthritis, and a variety of cardiovascular disorders. Free radicals in biological systems are scavenged by antioxidants through a variety of processes, including chelation and quenching of singlet oxygen molecules. Plants that possess antioxidant properties have a significant role in reducing the oxidation of lipids by donating electrons and scavenging free radicals. These secondary metabolites have many more positive effects on human health besides their antioxidant capacity.[9] Various illnesses have been treated with drugs derived from plants in the traditional medical system. The majority of people on the planet—roughly 75–80%—rely mostly on herbal remedies. The majority of the plants had therapeutic value, and they were tested for novel, potent chemicals. Treatment for serious illnesses is greatly aided by the many phytochemicals found in plants. The term "cardiospermum," which describes the white pattern of a heart-shaped seed, is derived from the Latin words "cardio," which means heart, and "sperma," which means seed. The Latin term "halicacabus," which describes a plant with enlarged fruits, is where the name "halicacabum" originates.[10] Often referred to as "Balloon vine," Cardiospermum halicacabum L. (Sapindaceae) is a dioecious, hairy climbing vine with delicately divided, delicate leaves framing ballon-like clusters of

white flowers. The entire plant, including the bitter leaf, possesses anti-inflammatory, antibiotic, antiparasitic, antipyretic, and analgesic properties against certain microorganisms. Significant anti-arthritic effects are shown by the ethanolic leaf extract.[11] Medicinal plants naturally contain bioactive phytochemical elements that can be used to treat a variety of illnesses due to the physiological effects they have on the human body. Therefore, to ascertain the potential of these native sources of medicinal compounds, medicinal plants must be assessed for phytochemistry. Balloon vine, or *Cardiospermum halicacabum L*, is a member of the Sapindaceae family. *C. halicacabum* is a medicinal plant that is high in quebrachitol, D-glucoside, saponin, and β-sitosterol. Additionally, *C. halicacabum* is used to treat rheumatism, asthma, earaches, muscle aches, mental disorders, diarrhea, dysentery, nephritis, oliguria hemorrhoids, and rheumatism. For several centuries, the entire plant has been used to treat atrophic arthritis, limb stiffness, and snakebite; a decoction made from its roots is used as a diuretic, emetic, and laxative; a decoction made from its leaves and stems is used to treat headaches, diarrhea, and dysentery; and an ointment made from them is used to treat swelling.[12] Any plant that has therapeutic qualities has a range of secondary metabolites present in it. The leaves, stems, and roots of medicinal plants all naturally contain phytochemicals that are essential in the treatment of many ailments. To make the search for a plant's specific medicinal efficacy easier, the phytochemical components are crucial. As a result, there is a growing need to research the phytochemicals found in different plants.[13] Cardiospermum halicacabum, often known as balloon vine in English or Welpenela in Sinhala, is a widespread annual or occasionally perennial herb found throughout Sri Lanka's lowlands. The entire plant, a small, delicate, smooth climber, has been used for generations to treat rheumatism, limb stiffness, and snakebites. For bleeding piles, a decoction of roots is used. The roots are used as a diaphoretic, diuretic, emmenagogue, laxative, refrigerant, stomachic, and sudorific in addition to treating nervous disorders. Patients with asthma are given fresh leaf juice, which also helps lower weight. The leaves are also one of the components of a medication for irregular menstrual cycle suppression. Boiling leaves in oil, like castor oil, is administered to tumors and swellings associated with rheumatism. According to several research, ethanol extract from leaves has antibacterial and antidiabetic properties. Several preparations of this plant have been reported to contain flavones, aglycones, triterpenoids, glycosides, a variety of fatty acids, and volatile ester.[14] Many different types of illnesses have long been treated with plant-based treatments in conventional medical systems throughout the world. For basic medical care, almost 80% of people on the planet still rely on medicinal plants, especially in places where access to contemporary drugs

is limited. Eco-friendly and bio-friendly plant-based products are increasingly being explored globally for the prevention and treatment of various human ailments, including microbial diseases. Additionally, the use of plants in traditional medicine is growing. With numerous plant species flourishing in diverse parts of the country, nature has bestowed upon us a tremendous botanical treasure.[15] Ayurveda describes *C. halicacabum* (Jyotishmati) as a medicine for piles, rheumatism, bronchitis, and neurological disorders. The plant's decoction has laxative, diuretic, and diaphoretic properties1. The plant's diuretic action in test animals has already been documented recently.[16] Antibacterial, antifungal, antiparasitic, antidiarrheal, anxiolytic, rubefacient, antipyretic, anti-inflammatory, anticonvulsant, and anticarcinogenic are only a few of the therapeutic qualities that C. halicacabum demonstrates. Leaf juice can be used as an eardrop to relieve earaches. It promotes healthy hair growth. The scalp is treated with C. halicacabum leaves. The extract works well as a herbal remedy for redness in the skin. It controls how reactions behave. Antipruritic qualities result from this. This plant can be utilized for an extended period because it does not have a hematoma. Small amounts of cardiac glycosides are present in the extracts and are beneficial in treating neurodermatitis-like illnesses in chronic phases. It also prevents medications from working. As such, it has immunosuppressive effects. The extract can be used to treat eczema as well as other skin conditions. Additionally, root extract is used. Roots provide immediate relief from aches, pains, swelling, and arthritis. This plant's leaves can also be consumed to treat diarrhea. Root extracts can be used to treat hemorrhoids. You can also make herbal tea.[17] The present research focuses on the pharmacognostic investigations of *Cardiospermum halicacabum L* Leaves. The plant *Cardiospermum halicacabum L* was present in fig 1.

Taxonomical Classification

Kingdom : Plantain

Sub kingdom : Tracheobionta

Superdivision : Spermatophyta

Division : Magnoliophyta

Class : Magnoliophyta-Dicotyledons

Sub class : Rosidae

Order : Sapindales

Family : Spindaceae-Soapberry family

Genus : *Cardospermum L*

Specie : *Cardiospermum halicacabum L*

Botanical name : *Cardiospermum helicacabum L.*

MATERIALS AND METHOD

Plant Collection and Authentication

Leaves of the plant Cardiospermum halicacabum L. selected for our study were collected from Viswanathepperi, Tenkasi District, Tamil Nadu, India in September 2020 and were authenticated by Dr. D. Stephen, Department of Botany, American College, Madurai.

Leaf drying and Pulverizing

The leaves were collected and shade-dried. It was powdered in a mixer. The powder was sieved in a No.60 sieve and kept in a well-closed container in a dry place.

Pharmacognostical Studies

In pharmacognostical research, morphological and micromorphological analysis and characterization of medicinal plants have always been given the proper weight. Before analyzing a plant's potential medical uses, it is important to ascertain its botanical identity. A researcher can discover a novel component or numerous beneficial pharmacological active qualities in the plant. The entire study of the plant is nullified if its botanical identity turns out to be uncertain or inconsistent. It is, therefore, unnecessary to emphasize that the first step in any pharmacological inquiry method is determining the crude drug's botanical identity. All potential diagnostic parameters for the plant they intend to study should be available to the researchers.

Morphological studies of Cardiospermum halicacabum L.

The external feature of the test sample was documented using Nikon COOLPIX 5400 digital camera (Table 1)

Microscopical Studies on the leaf of Cardiospermum halicacabum L.

Collection of Specimen

The selection of healthy plants and normal organs was done with great care. Using petioles, specimens of leaves and petioles were removed from a healthy plant. After the materials were chopped into bits, they were submerged right away in the fixative fluid FAA (5 ml of formalin, 5 ml of acetic acid, and 90 ml of 70% ethanol).

Microscopical Study of Leaf

The sample was kept for more than 48 hours in fixative FAA. Using a sharp knife, the preserved specimens were divided into thin transverse pieces, which were then dyed with safranin. Nikon ECLIPSE E200 trinocular microscope coupled to Zeiss AxioCam Erc5s digital camera was used to take transverse section photos in bright field light. A scale bar was used to show the magnifications (Figure 2–4).

Quantitative Microscopy

Using normal techniques, the vein islet number, vein terminal number, stomatal number, and stomatal index were assessed on fresh leaves (Table 2).

Vein islet number and vein termination number

The tiny region of photosynthetic tissue surrounded by the final divisions of the conducting strands is referred to as a vein islet. The vein islet count per square millimeter. The vein islet number refers to the area. One way to describe vein terminal number is the number of vein terminals found in a square millimeter (sq. mm) of photosynthetic tissue.

Determination of vein islet number and vein termination number

A tiny square piece of the leaf's lamina was cleaned with chloral hydrate, stained, and placed on a slide. A camera Lucida is set up, and the paper is split into 1mm2 squares using a 16mm objective on a stage micrometer. The cleared preparation is then used in place of the stage micrometer, and the veins are raced in four consecutive squares, either as a rectangle measuring 1 mm by 4 mm or as a square measuring 2 mm by 2 mm. It is convenient to number each vein islet on the tracing when counting. Veins must entirely enclose each numbered region; unfinished areas are not counted if they are cut by the top and left edges of the square (or) rectangle, but counted if they are cut by the other two sides. Vein islet and vein termination number readings were recorded ten times.

Stomatal Index

It represents the proportion of stomata—each counted as a single epidermal cell—to the total number of epidermal cells.

$$\text{Stomatal index} = S/S+E \times 100$$

Where, S = Number of stomata per unit area.

E = Number of epidermal cells in the same unit area.

Determination of Stomatal index

Under high power (45 X), the method used to determine the stomatal number was observed. Both the stomata and the epidermal cells were counted. Using the formula above, the stomatal index was computed from these values.

Powder Microscopy

On a tiny slide, a pinch of the powdered material was placed with a drop of 50% glycerol. Using a Nikon ECLIPSEE200 trinocular microscope, characteristics were noticed. ZeissERc5s digital camera attached under bright field light. Diagnostic character photomicrographs were taken and recorded. (Figure 5)

Physicochemical Parameters

The powder is exposed to a variety of physicochemical parameters, including extractive values with varying solvents in increasing order of polarity, loss on drying, and foreign organic matter. The process was approved by James (1995) and WHO recommendations from 1996, 1998, and 2001. (Table 3)

Determination of foreign organic matter procedure

100g of coarse medication that has been air dried and precisely weighed was spread out in a thin layer. The drug sample was examined using both unassisted vision and a 6x lens. The foreign organic matter was manually separated as thoroughly as possible before being weighed. The weight of the medicine ingested was taken into consideration when calculating the proportion of foreign organic materials.

Determination of Ash values

Ash value

According to the prescribed procedure, air-dried leaf powder was used to calculate the ash levels.

Total ash

Separately, two grams of the air-dried leaf powder were precisely weighed in a silicon crucible. The powder was evenly distributed into a fine layer on the crucible bottom and burned by progressively raising the temperature to a maximum of 4500 ˚C until it was carbon-free. After cooling, it was weighed to ensure a consistent weight. It was computed to find the proportion of ash in the air-dried powder.

Water soluble ash

After boiling the ash from the entire ash method for five minutes with 25 milliliters of water, the insoluble material was gathered on ash-free filter paper and rinsed with hot water. After that, it was lit for fifteen minutes at a temperature not to rise above 450 ˚C. The weight of the whole amount of ash was deducted from the weight of the insoluble substance. The water-soluble ash is represented by the weight differential. Concerning the powder that had been air-dried, the percentage of water-soluble ash was computed.

Acid insoluble ash

Five minutes were spent boiling the ash obtained from the whole ash with 25 milliliters of diluted hydrochloric acid. A tarred sintered glass crucible used to capture the insoluble materials was used. After being cleaned with hot water, the residue was dried and weighed. About the medicine that had been air dried, the percentage of acid-insoluble ash was computed.

Determination of loss on drying

To calculate the loss upon drying, the Wallis method was employed. A tarred Petri dish containing one gram of dried powdered leaf was precisely weighed after it had been dried according to IP'96 guidelines. The powder was shaken gently from side to side to disperse it as evenly as possible. For an hour, the dish was dried in an oven between 100 and 105 ˚C. After cooling in desiccators, it was weighed once again. The quantity of the dried powder taken was used to compute the drying loss.

EXTRACTIVE VALUES

Petroleum Ether Soluble Extractive Value

Within a closed flask, five grams of the coarsely ground powder were macerated separately for a full day with 100 milliliters of petroleum ether. For the first six hours, it was shaken a lot then left to stand for eighteen hours. After that, it was quickly filtered while being careful not to lose any petroleum ether. A shallow dish with a tarred bottom, filled with 25 milliliters of the filtrate, was dried at 105 degrees Celsius and weighed. Using the air-dried powder as a reference, the percentage of the petroleum ether soluble extractive value was determined.

Ethanol soluble extractive value

100 milliliters of ethanol were macerated with five grams of the coarsely ground powder in a closed flask for a full day. For the first six hours, it was shaken a lot then left to stand for

eighteen hours. After that, it was quickly filtered while being careful not to lose any ethanol. In a shallow dish with a tarred bottom, 25 ml of the filtrate was evaporated until it was completely dry, dried at 105 ˚C, and weighed. The air-dried powder was used as a reference to compute the percentage of the ethanol-soluble extractive value.

Water Soluble Extractive value

In a closed flask, five grams of the coarsely ground powder were macerated separately for 24 hours with 100 milliliters of chloroform water. For the first six hours, it was shaken a lot then left to stand for eighteen hours. After that, it was quickly filtered while being careful not to lose any chloroform water. A shallow dish with a tarred bottom, filled with 25 milliliters of the filtrate, was dried at 105 degrees Celsius and weighed. Using the air-dried powder as a reference, the percentage of the chloroform water-soluble extractive value was determined.

Fluorescence Analysis of Powdered Leaf

After being treated with a variety of chemical and organic reagents, including ethanol, ethyl acetate, chloroform, water, 50% sulphuric acid, 10% sodium hydroxide, 50% nitric acid, and dried leaf powder, powdered C. halicacabum leaf material was examined under a UV lamp. The outcome is shown in Table 4.

RESULT AND DISCUSSION

The three primary components of pharmacognostical research are powder microscopy, microscopical features, and morphological characters. Studying physicochemical constants such as ash values, extractive values, and loss upon drying the powdered leaves is also part of it. Studies of leaves under a microscope have also been done. Finding the similarities and differences among plants that show a closer kinship with their common ancestors is the goal and objective of taxonomy. It is a methodical approach to labeling, characterizing, and organizing plants according to science. Certain distinctive features of a wide number of plant families allow for the simultaneous study of crude medicines from these species.

Microscopy is a crucial instrument for assessing raw pharmaceuticals. It can be used for several purposes, including studying powdered medications, identifying raw pharmaceuticals, and observing calcium oxalate crystals. A medication can be examined in greater detail using the microscopy method. Utilizing their recognized histological characteristics, it is possible to distinguish the organized medications. Its primary application is the qualitative assessment of

whole and powdered organized crude pharmacological formulations. The physical characteristics are studied using extractive values and ash values.

Morphological Features of Cardiospermum halicacabum linn.

At its base, balloon-vine is a perennial creeper that can grow up to two meters tall. Its stem is only around 3 mm thick. The stem is five to ten centimeters long and has internodes. The leaves on the grooved stem are arranged in pairs and range in length from 3 to 5 cm. They can be hairless or have a gentle down of hairs covering them. The macro characteristics of the Cardiospermum halicacabum's leaves, stem, flower, fruits, seeds, and root were examined; the findings are shown in Table 1.

Stem

Color: Green color

Shape: Stems with minute lypuberulous, sometimes slightly

Woody : Tendrils present,5or 6-sulcate,slender,glabrousor sparsely hairy

Flowers

Description: Axillary heads are usually 3 flowers by abortion, white with a yellowish center Irregular flowers are borne in panicles (3, 6). Each flower bears four sepals, two large and two small, four whitish petals. Petaloid appendages are at the base of each flower.

Size: 4mm long

Colour: Milky white

Ovary: 3-celled ovary bears one ovule per cell

Stamens: 8 stamens present

Fruits

Shape: Inflated, papery capsule

Size: 3 chambers, 3-4.5cm in diameter

Color: Before ripe- green color, After ripe-slight yellow color

Ribes: 8-10 prominent longitudinal ribs not covered with spines or Papillae

Seeds

Shape: Opaque, finely porous heart shape

Color: Black, smooth with white, Size: 5mm diameter

Microscopy

The leaf is dorsiventral and amphistomatic.

Transverse section of Rachis

The Rachis transverse section has an irregular pentagonal shape, is deeply grooved in the upper region, has a continuous, roughly two-layered pericycle made up of sclerenchymatous cells surrounding the central stelar region, which displays conjoint, closed, collateral vascular bundles, a centrally placed pith with thin-walled parenchyma visible, and trace bundles present in the upper winged region (Figure 2).

The transverse section of Petiolule

The transverse section of the petiolule has an ovate-lanceolate form and an upper side with long, winged growth that grows horizontally; the epidermis is single-layered, with a distinct cuticle and a large number of glandular and simple covering trichomes; The pericycle is made up of two to three layers of sclerenchyma cells enclosing the parenchymatous stelar region, which is composed of three conjoint collateral vascular bundles, the largest of which is the basal one. The hypodermis is composed of three to five layers of collenchymatous cells containing cluster and prismatic crystals; two to three layers of parenchymatous cells are visible beneath the hypodermis encircling the pericycle; thin-walled parenchyma constitutes the core pith; the winged region has two layers of palisade parenchyma beneath the epidermis, and each wing has a tiny vascular bundle with a pericyclic cap (Figure 3).

Transverse section of lamina through midrib

The leaf's transverse section is dorsiventral and amphistomatic; it passes through the midrib of the leaflet and has a broad convex basal side and a narrow projection on the upper side. The epidermis is single-layered, covered in cuticle, and is traversed by covering, with a glandular trichome visible as the outermost layer. Two to four layers of collenchymatous cells are present beneath the epidermis, followed by thin-walled parenchymatous layers. There is a little vascular bundle on the upper side and a huge conjoint collateral vascular bundle in the center (Figure 4).

Lamina

A transverse section of the lamina reveals the following: a well-differentiated mesophyll tissue with minor veins embedded in it; 2 to 4 layers of columnar cells forming the palisade

layer below the upper epidermis; and 2 to 3 layers of isodiametric spongy cells present towards the lower epidermis (Figure 4). The epidermis is covered in a striated cuticle.

Quantitative Microscopy

Table 2 contains the quantitative characteristics that were measured while seeing leaf epidermal peelings under a microscope. Figure 5 depicts a leaf with a large number of anomocytic stomata on the lower surface and a few on the upper surface.

Powder microscopy

The following microscopical characteristics of Cardiospermum halicacabum powder leaves have been noted by us. The results of the powder microscopy revealed: fiber with cluster crystals, annular, reticulate, and spiral arteries; fiber with a small lumen; thin-walled parenchyma; epidermal cells with anomocytic stomata; simple and capitates glandular trichomes; palisade and spongy parenchyma cells (Figure 6).

Physicochemical Parameters

For the powdered leaves of Cardiopermum halicacabum, physicochemical characteristics such as ash value, loss on drying, and extractive value were measured. The results are shown in Table 3.

Determination of foreign organic matter procedure

100g of coarse medication that has been air dried and precisely weighed was spread out in a thin layer. The drug sample was examined using both unassisted vision and a 6x lens. The foreign organic matter was manually separated as thoroughly as possible before being weighed. The weight of the medicine ingested was taken into consideration when calculating the proportion of foreign organic materials.

Determination of ash values

Ash Value

According to the prescribed procedure, air-dried leaf powder was used to calculate the ash levels.

Total Ash

Separately, two grams of the air-dried leaf powder were precisely weighed in a silicon crucible. The powder was evenly distributed into a fine layer on the crucible bottom and burned by progressively raising the temperature to a maximum of 4500 ˚C until it was

carbon-free. After cooling, it was weighed to ensure a consistent weight. It was computed to find the proportion of ash in the air-dried powder.

Water Soluble Ash

After boiling the ash from the entire ash method for five minutes with 25 milliliters of water, the insoluble material was gathered on ash-free filter paper and rinsed with hot water. After that, it was lit for fifteen minutes at a temperature not to rise above 450 ˚C. The weight of the whole amount of ash was deducted from the weight of the insoluble substance. The water-soluble ash is represented by the weight differential. Concerning the powder that had been air-dried, the percentage of water-soluble ash was computed.

Acid Insoluble Ash

Five minutes were spent boiling the ash obtained from the whole ash with 25 milliliters of diluted hydrochloric acid. A tarred sintered glass crucible used to capture the insoluble materials was used. After being cleaned with hot water, the residue was dried and weighed. About the medicine that had been air dried, the percentage of acid-insoluble ash was computed.

Determination of loss on drying

To calculate the loss upon drying, the Wallis method was employed. A tarred Petri dish containing one gram of dried powdered leaf was precisely weighed after it had been dried according to IP'96 guidelines. The powder was shaken gently from side to side to disperse it as evenly as possible. For an hour, the dish was dried in an oven between 100 and 105˚C. After cooling in desiccators, it was weighed once again. The quantity of the dried powder taken was used to compute the drying loss.

EXTRACTIVE VALUES

Petroleum Ether Soluble Extractive Value

Within a closed flask, five grams of the coarsely ground powder were macerated separately for a full day with 100 milliliters of petroleum ether. For the first six hours, it was shaken a lot then left to stand for eighteen hours. After that, it was quickly filtered while being careful not to lose any petroleum ether. A quarter of the filtrate was evaporated until it was completely dry in a shallow dish with a tarred bottom, dried at 105˚C, and weighed. Using the air-dried powder as a reference, the percentage of the petroleum ether soluble extractive value was determined.

Ethanol Soluble Extractive Value

100 milliliters of ethanol were macerated with five grams of the coarsely ground powder in a closed flask for a full day. For the first six hours, it was shaken a lot then left to stand for eighteen hours. After that, it was quickly filtered while being careful not to lose any ethanol. In a shallow dish with a tarred bottom, 25 milliliters of the filtrate were dried at 105˚C and weighed. The air-dried powder was used as a reference to compute the percentage of the ethanol-soluble extractive value.

Water Soluble Extractive Value

Five grams of the coarsely ground powder were macerated in a closed flask for 24 hours separately with 100 milliliters of chloroform water. For the first six hours, it was shaken a lot then left to stand for eighteen hours. After that, it was quickly filtered while being careful not to lose any chloroform water. A quarter of the filtrate was evaporated until it was completely dry in a shallow dish with a tarred bottom, dried at 105˚C, and weighed. Using the air-dried powder as a reference, the percentage of the chloroform water-soluble extractive value was determined.

Fluorescence Analysis of Powdered Leaf

After being treated with a variety of chemical and organic reagents, including ethanol, ethyl acetate, chloroform, water, 50% sulphuric acid, 10% sodium hydroxide, 50% nitric acid, and dried leaf powder, powdered C. halicacabum leaf material was examined under a UV lamp. Table 4 displays the outcome.

Table 1: Morphological features of *Cadiospermum halicacabum linn.*

Colour	Paleorlight green
Dorsal	Light green
Ventral	Dark green
Odour	Characteristic odour
Taste	Bitter
Shape	Ovate –lanceolate
Apex	Acute
Length	2-4cm
Petiole length	1.5–2.5cm
Margin	Dentate
Arrangement	Ternately bicompound
Base	Obtuse-turnicate
Venation	pinnate
Texture	Glabrous

Table 2: Quantitative microscopy of *Cardiospermum halicacabum* leaflet.

Parameters	Upper epidermis (/mm^2)	Lower epidermis (/mm^2)
Epidermal number	920-940	950-980
Stomatal number	78-90	450-480
Stomatal index	8.30	32.50
Palisad ratio		10-12
Vein islets number		50-58
Vein termination number		115-125

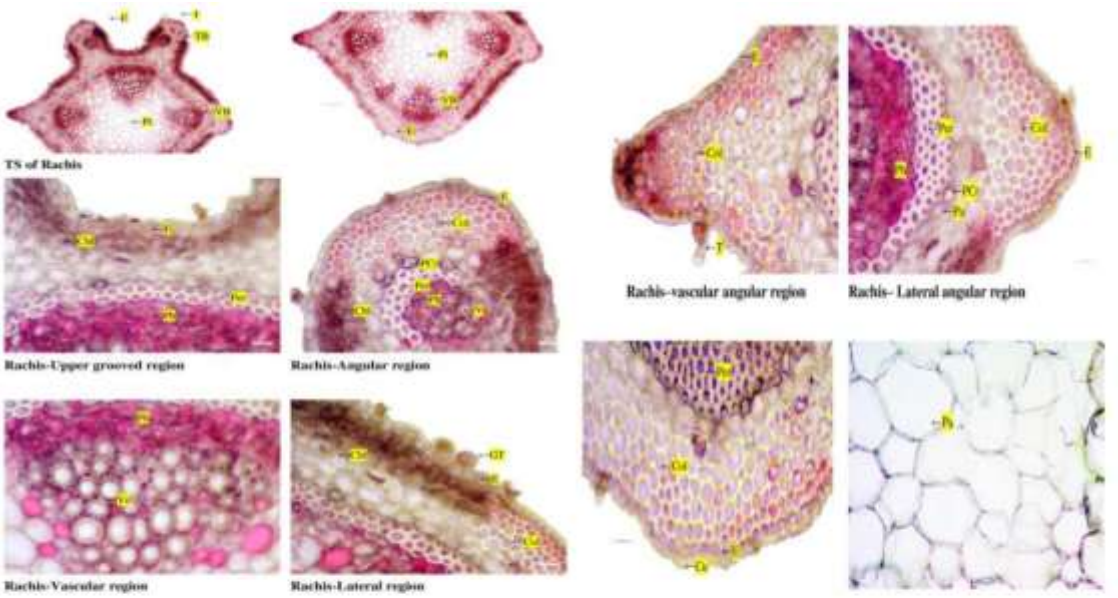
Table 3: Physiochemical parameters for the Leaves of *Cardiospermum halicacabum*.

Physicochemical Parameters	Results (%W/W) Mean±SEM
Foreign Organic Matter	NIL
Total ash value	6.86±0.352987
Acid insoluble ash value	1.04±0.5004
Water soluble ash value	4.04 ±0.014
Loss on drying	6.48%w/w±0.267644
Extractive value (Ethanol)	13.8±0.260342
Extractive value (Chloroform)	3.9±0.152753
Extractive value (Petroleum ether)	4.56±0.145297
Extractive value (Benzene)	6.9±0.120185
Extractive value (Acetone)	4.2±0.145297
Extractive value (Water)	10.3±0.41633

Table 4: The Fluorescence Analysis.

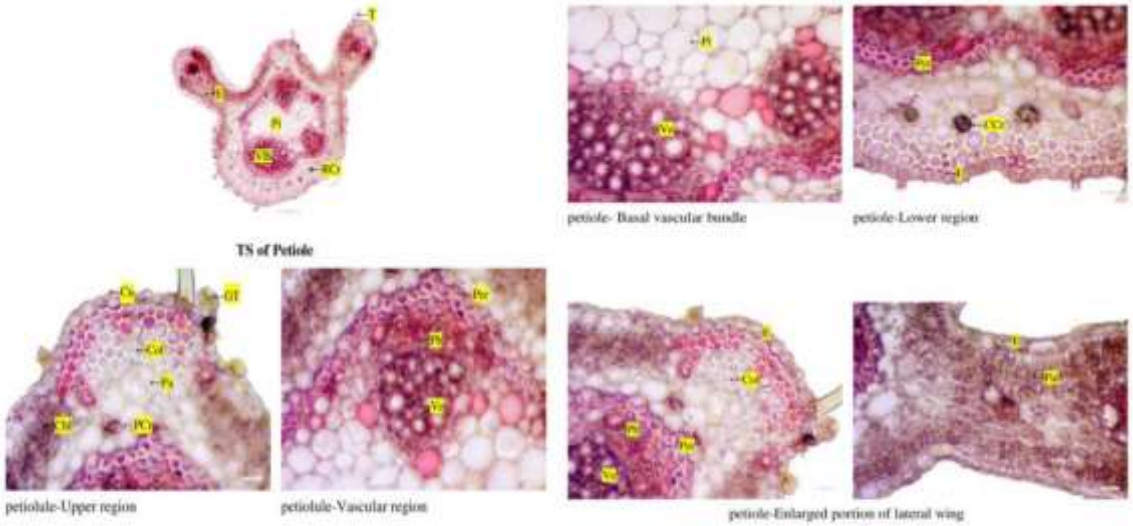
S.No	Treatment	Visible Light	UV 254 nm	UV 365 nm
1	Powder + Water	Light green	Green	Brownish green
2	Powder + 1N NaOH	green	Black	Greenish black
3	Powder + Picric acid	Green + Yellow	Black green	Black
4	Powder + Acetic acid	Green brown	Black green	Green or Grey
5	Powder + 1N Hcl	Brownish green	Black green	Black
6	Powder + 1N Hcl	Green brown	Black green	Black
7	Powder + 5N Iodine	Brown green	Dark brown	Black

Fig. 1: *Cardiospermum halicacabum L* plant.



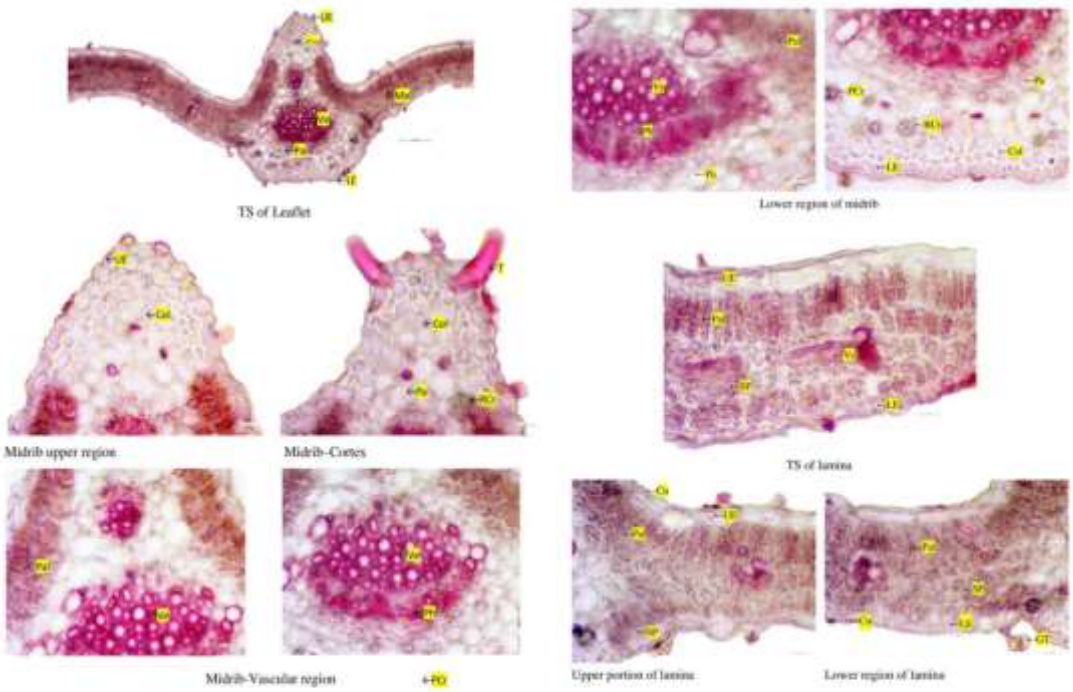
Chl - chlorophyll; **Col** - collenchyma; **Cu** - cuticle; **E** - epidermis; **GT** - glandular trichome; **Pa** - parenchyma; **PCr** - prismatic crystal; **Per** - pericycle; **Ph** - phloem; **Pi** - pith; **T** - trichome; **TB** - trace bundle; **VB** - vascular bundle; **Ve** - vessel.

Fig. 2: TS of *Cardiospermum halicacabum* rachis.



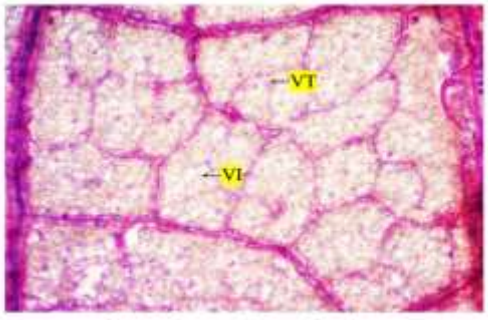
CCr –cluster crystal; **Chl**-chlorophyll;**Col**-collenchyma;**Cu**-cuticle;**E**-epidermis; **GT** -glandular trichome; **Pa**-parenchyma;**Pal**-palisade;**PCr**-prismatic crystal; **Per**-pericycle; **Ph** - phloem; **Pi** - pith; **T** - trichome; **VB** - vascular bundle; **Ve** - vessel.

Fig. 3: TS of *Cardiospermum halicacabum* petiolule.

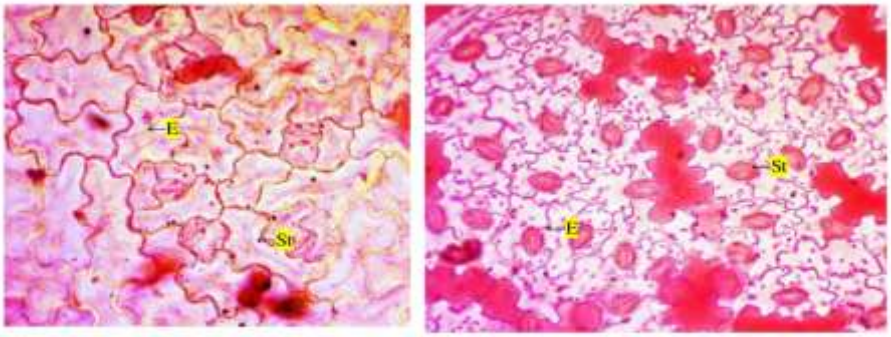


Col - collenchyma; **Cu** - cuticle; **GT** - glandular trichome; **LE** - lower epidermis; **Me** - mesophyll cells;**Pa** - parenchyma; **Pal**- palisade; **PCr**- prismatic crystal; **Ph** - phloem; **RCr** - rosette crystal;**SP**-spongy parenchyma;**T**-trichome;**UE**-upper epidermis;**Ve**-vessel.

Fig. 4: Transverse section of lamina through midrib.



Vein islets and Termination



Upper epidermis Lower epidermis

E- Epidermis;**St**-stomata;**VI**-vein islet;**VT**- vein termination

Fig. 5: Quantitative microscopy of *Cardiospermum halicacabum* Leaflet.

Fig. 6: Powder microscopy of *Cardiospermum halicacabum* Leaf.

CONCLUSION

The focus of this work is the pharmacognostical analysis of the leaves of Cardiospermum halicacabum, an edible plant that is commonly available and a member of the Sapinadaceae family. According to ethnomedical data, it was used to treat a wide range of illnesses, such as rheumatoid arthritis, gastrointestinal disorders, stomachaches, body aches, backaches, fevers, lumbago, nerve diseases, demulcents, dropsy, and so forth. The morphological analysis demonstrated that general characteristics adhered to the family. The leaf's characteristic vascular bundle, ranunculaceous stomata, non-glandular, glandular simple, unicellular or multicellular, unbranched uniseriate trichomes on the upper and lower epidermis, and other features were revealed by detailed microscopical analysis. A cluster of angular collenchyma cells can be seen in the inner region of the adaxial cone, while sclerenchyma cells can be found in the inner region of the abaxial cone. The petiole has two noticeable grooves on the upper side, while the epidermis on the bottom side is made up of a single layer of cells. The following were determined and presented: powder microscopy, microscopic schedules, stomatal number and index, vein islet and vein termination number, palisade ratio, and physicochemical parameters including ash values, extractive values, and loss on drying.

Conflict of Interest

There are no conflicts of interest in this review study, the authors guarantee.

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