Study on the Phytochemical Components of the Medicinal Plant Cardiospermum Halicacabum L.

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Abstract

Pharmacognostic and fluorescence analysis, phytochemical and antimicrobial screening against selected Gram positive and Gram negative bacteria were performed on crude extracts from the leaf and stem of Cardiospermum helicacabum in various solvents. For phytochemical screening and antibacterial activities, acetone, alcohol, benzene, chloroform, and aqueous extracts of leaf and stem were utilized. According to phytochemical research, the leaf and stem contain a diverse range of secondary metabolites. In all five solvent extracts of leaf examined, phenol, tannins, and saponins were identified in the highest concentrations, followed by steroids, sugars, flavonoids, and terpenoids (Benzene and acetone). Similarly, phenol, tannin, and amino acids were identified in abundance in all of the stem's solvent extracts. None of the solvent extracts of the stem contained triperpenoids. All of the extracts had variable levels of inhibitory potential against all of the microorganisms that were tested. Leaf extracts in acetone and chloroform demonstrated greater inhibitory activity against Salmonella typhi and Streptococcus subtilis, respectively. Acetone extracts of the stem exhibited the most inhibitory effect on S. typhi, whereas benzene extracts of the stem had a moderate inhibitory effect on Escherichia coli.

Keywords: *Cardiospermum halicacabum; phytochemical screening; pharmacognostic; antibacterial*.

I. INTRODUCTION

Plant-based remedies have long been utilized to treat a variety of ailments in traditional medical systems across the world. Around 80% of the world's population still relies on medicinal plants for basic health care, particularly in areas where modern medications are unavailable. Plant-based commodities that are eco-friendly and bio-friendly have lately been considered for the prevention and treatment of many human illnesses, including microbial diseases, all over the world, and plant use in ethno medicine is on the increase. Nature has given on us a vast botanical treasure, with many different species of plants growing in various sections of the nation.

India has a high amount of biodiversity on all three levels: species diversity, genetic diversity, and habitat diversity. Herbal medicine is still the primary source of nutrition for around 75-80% of the world's population, primarily in underdeveloped nations. These plants include a variety of phytochemicals and active biomolecules that aid in the treatment of life-threatening disorders. Various plants have been studied in order to find novel and beneficial substances as well as to figure out how to prevent many illnesses. Thousands of species are known to have therapeutic value in India, and the usage of various sections of medicinal plants to treat certain ailments has been popular since ancient times. Cardiospermum halicacabum L., a member of the Sapindaceae family, is one such plant frequently utilized by traditional healers to treat a variety of diseases. Cardiospermum is derived from the Latin words cardio, which means heart, and sperma, which means seed, and alludes to the seed's white heart-shaped pattern. The name Halicacabum comes from the Latin word halicacabus, which refers to a plant with inflated fruits. It's a little, delicate, smooth climber, and the entire plant has been used for millennia to cure a variety of diseases.

Figure 1. Seeds of C. halicacabum Linn

Figure 2. Whole plant of C. halicacabum Linn.

Cardiospermum halicacabum Linn is a climbing plant that grows beside highways and waterways as a weed. It is a tropical and subtropical African and Asian annual or perennial climber with a wide distribution. The plant's young leaves can be used as a vegetable.

II. PHARMACOLOGICAL ACTIVITY

The medicine is made out of the plant's blooming aerial parts, which have a cortisone-like effect and are effective against inflammatory allergic skin responses and itching. Cardiospermum extracts are now used to treat inflammatory dermatitis, hives, eczema, and insect bites. Phytosterols, which have anti-inflammatory, moisturizing, sebum-regulating, anti-pruriginous, calming skin redness, and preventing flaking properties, are the active substances responsible for the cortisone-like action. The antioxidant activity of phytosterols also helps to relieve pain associated with arthritis and rheumatism, since antioxidant power inhibits the action of inflammatory enzymes and peroxilipids that damage cells, resulting in antiphlogistic action.

Antibacterial capabilities of various plant components extracted with various solvents (diethyl ether, chloroform, acetone) were evaluated against gram-negative (Escherichia coli, Pseudomonas, Aeromonas, Salmonella) and gram-positive (Staphylococcus aureus) bacterial strains. In comparison to the control with ofloxacin, the evaluation was done 24 hours following the minimum zone of inhibition.

The antibacterial action was attributed to flavonoid, terpene substance, and tannin content, which were all present in all extracts.

Apigenin and luteolin, two flavonoids found in the plant, have been proven to have anti-hyperglycemic, antioxidant, and anti-cancer properties. Apigenin has been demonstrated to have an inhibitory impact on the aldose-reductase enzyme, making it effective in the prevention of type 2 diabetes chronic sequelae such as peripheral neuropathy, retinopathy, and cataracts caused by sorbitol buildup in the cells.

Luteolin has been widely studied in cancer research due to its fascinating biological features. The effects of luteolin on various types of experimental tumours, its ability to influence the activity of certain cellular enzymes such as 15-lipoxygenase, its involvement in inflammatory reactions with the genesis of leukotrienes 5'-nucleotidase, which converts AMP to phosphate and adenosine, and its mediation of multiple biochemical effects have all been documented in numerous published scientific articles. Furthermore, it prevents cancer from starting and progressing by interfering with transcription factors and kinases involved in tumour transformation, such as phosphatidylinositol-3-kinase (PI-3k), which regulates insulin-regulated glucose metabolism, and other cellular functions linked to oncogenesis. Luteolin is a common dietary flavonoid that has long been used in traditional Chinese medicine to treat hypertension and inflammatory illnesses, showing that it is safe for clinical usage; it might be a promising cancer therapy option.

III. MATERIALS AND METHODS

- **Preparation of plant extracts**

Fresh Cardiospermum helicacabum L. plants were taken from the Saraswathi Narayanan College campus and identified using Gamble's Flora. To eliminate the shadow, the plant material was cleaned with water and dried at room temperature. The extracts were made using the technique. In an electric blender, the dried plant components were mashed into fine powder and sieved to achieve fine powder. The soaking plant powder was filtered and utilized in qualitative, phytochemical, and antimicrobial tests as is.

- **Analysis of fluorescence pharmacognostic characters**

Powders obtained from shade dried plants, as well as acetone, alcohol, chloroform, benzene, and water extracts, were used for fluorescence examination. 1N aqueous NaOH, 1N ethonolic NaOH, 1 N H_2SO_4 and 1N HNO_3 were used to treat the powders individually. Under UV light and regular daylight, the supernatants were analyzed. The pharmacognostic characteristics of Cardiospermum helicacabum were investigated using a standard approach specified in the Indian Pharmacopeia.

- **Phytochemical screening**

The major natural chemical groups such as steroids, reducing sugars, alkaloids, phenolic compounds, saponins, tannins, flavonoids, amino acids, and anthracene glycosides were identified using phytochemical screening to assess the qualitative chemical composition of crude extracts using commonly used precipitation and coloration. The presence or absence of these chemicals in the crude extracts analyzed was shown by general responses in these analyses. The phytochemical assays were conducted using crude extracts of the plants that had been produced and kept in the refrigerator.

- **Collection of microorganisms and preparation of media**

Bacillus subtilis, E. coli, Pseudomonas aeroginosa, Klebsiella pneumoniae, Citrobacter freundi, Strepto coccus aureus, and Salmonella typhi were all acquired as stock cultures. Nutrient agar and nutrient broth were used as growth medium in this experiment. The medium was adjusted to pH 7.4 and autoclaved for 15 minutes at 120°C.

- **Screening for antibacterial potential**

The disc diffusion technique was used to measure antibacterial activity. Swabs of standard inoculum suspensions were swabbed across the media surface. On the surface of the medium, oven dried discs impregnated with 20 l of leaf and stem extracts (1 mg/ml) were deposited. The diameter of the inhibition zone around the plant extract saturated discs was assessed after the incubation time as the difference in diameter between the discs (6 mm) and the growth free zone.

IV. RESULTS

- **Fluorescence analysis and quantitative determination of pharmacognostic characters**

Table 1 shows the findings of fluorescence examination of the powder and extracts in the visible and UV ranges. Table 2 shows the findings of the quantitative determination of pharmacognostic features of C. helicacabum, which were useful in determining the medicinal plant's pharmacognostic value. The moisture, total ash, acid insoluble ash, and water soluble ash contents of leaf and stem extracts were determined to be 73.7 % and 75.2 %, 88.8 % and 92 %, 17.31 % and 15.35 %, and 10% and 9.33 %, respectively. Leafs had a higher percentage of water soluble ash (10%) than stems (9.33 %). When ethanol extracts of leaf and stem were compared to other solvents, the ethanol extract had a higher extractive value.

Table 1. Analysis of fluorescence characters of leaf and stem powders and extracts of Cardiospermum helicacabum L. in different solvents

Sl. No.	Treatment	Under Day Light		Under UV Light	
		Leaf	Stem	Leaf	Stem
1.	Powder	Green	Green	Green	Green
2.	Powder + 1N NaOH	Light green	Pale green	Dark green	Dark green
3.	Powder + 1N NaOH (ethanolic)	Brownish yellow	Reddish brown	Blackish red	Brownish yellow
4.	Powder + 1N HCl	ale green	Light yellow	Yellow	Yellow
5.	Powder + H2SO4	Yellowish green	Yellow	Blackish green	Greenish yellow
6.	Powder + HNO3	Yellow	Yellow	Yellowish green	Greenish yellow
7.	Acetone	Yellowish green	Light green	Brownish green	Dark green
8.	Alcohol	Dark green	Dark green	Blackish green	Dark green
9.	Benzene	Pale green	Pale green	Dark green	Dark green
10.	Chloroform	Brownish yellow	Brownish yellow	Dark green	Brownish yellow
11.	Water	Light yellow	Light green	Dark yellow	Yellow

Table 2. Pharmacognostic characters of leaf and stem of Cardiospermum helicacabum L.

Parameters tested	Percentage Yield (%)	
	Leaf	Stem
Loss of weight on drying	73.7	75.2
Total ash	88.8	92
Acid soluble ash	10.5	15.33
Water soluble ash	17.31	9.35
Percentage of extractive yield values		
Acetone	60	56

Ethanol	96	73
Benzene	73	75
Chloroform	83	86
Water	90	92

- **Phytochemical screening**

The content of steroids, triterpenoids, sugars, alkaloids, phenols, saponins, amino acids, tannins, flavonoids, and anthracene glycosides was determined in several extracts of C. helicacabum leaf and stem, and the findings were shown in Table 3.

Table 3: Results of phytochemical screening of leaf and stem extracts of Cardiospermum helicacabum L.

Phyto- chemicals	Solvent extract used									
	Benzene		Chloroform		Ethanol		Acetone		Water	
	L	S	L	S	L	S	L	S	L	S
Steroids	+	+	+	+	+	+	+	+	-	-
Triterpenoids	-	-	-	-	-	-	+	-	-	-
Sugars	+	+	-	+	-	-	+	+	+	+
Alkaloids	+	+	+	+	-	-	+	+	-	+
Phenols	+	+	+	+	+	+	+	+	+	+
Saponins	+	+	+	+	+	+	+	+	+	+
Aminoacids	+	+	-	+	+	+	+	+	-	+
Tannins	+	+	+	+	+	+	+	+	+	+
Flavonoids	+	+	-	+	+	+	-	-	-	-
Anthracene glycosides	+	+	+	+	+	+	-	-	-	-

- **Antimicrobial activity**

The antibacterial activity of C. helicacabum leaf and stem extracts against S. aureus, B. Subtilis, C. freundii, E. coli, P. aeroginosa, S. typhi, and K. pneumoniae was investigated, and the findings are shown in Table 4.

Table 4. Antibacterial activity of various extracts of leaf and stem of Cardiospermum helicacabum L.

Bacterial strains	Solvent extract used									
	Benzene		Chloroform		Ethanol		Acetone		Water	
	L	S	L	S	L	S	L	S	L	S
Stepto-coccus aureus	2	2	0	1	3	3	1	2	0.5	0
Bacillus Subtilis	1.5	1	2	2	3	1	1.5	2	1	2
Citro-bacter freundii	1.5	1	0	0	2	1.5	1.5	2	0.5	0.5
Escherichia coli	1	2.5	0	0	1	2	1	1	1	0
Pseudomonas aeroginosa	2	2	0	0	1	0	2	1	0.5	2.5
Salmonella typhi	2	1.5	0.5	0	2	2	3	3.5	0.5	0

Values presented indicate the zone of inhibition formed around the discs (mm).

Streptococcus aureus was shown to be more sensitive to ethanolic leaf and stem extracts, with a maximal inhibitory zone of 3 mm each, followed by benzene (2 mm each), acetone (1 mm, 2 mm), chloroform (0 mm, 1 mm), and aqueous extracts (0 mm, 1 mm) (0.5 mm, 0 mm). Bacillus subtilis was shown to be more susceptible to ethanolic leaf and stem extracts, with a maximal inhibitory zone of 3 mm, 1 mm, followed by chloroform (2 mm each), acetone (1.5 mm, 2 mm), benzene (1.5 mm, 1 mm), and aqueous extract (1.5 mm, 1 mm) (1 mm, 2 mm). Citrobacter freundii was shown to be more responsive to ethanolic extracts of leaf and stem with a maximal inhibitory zone (2 mm, 1.5 mm), acetone (1.5 mm, 2 mm), benzene (1.5 mm, 1 mm), aqueous (0.5 mm, 0.5 mm), and chloroform extracts showed no inhibition. E. coli was found to be sensitive to benzene, which had the largest inhibitory zone (1 mm, 2.5 mm), followed by ethanol (1 mm, 2 mm), acetone (1 mm, 1 mm), aqueous (1 mm, 0 mm), and chloroform extracts, which had no effect on E. coli. Psuedomonas aeroginosa was found to be more responsive to benzene (2 mm, 2 mm), followed by acetone (2 mm, 1mm), ethanol (1 mm, 0 mm), aqueous (0.5, 0.5), and chloroform extracts. Acetone extracts (3 mm, 3.5 mm) were the most sensitive to Salmonella typhi, followed by ethanol (2 mm, 2 mm), benzene (2 mm, 1.5 mm), chloroform (0.5, 0 mm), and aqueous extracts (0.5 mm, 0 mm). Acetone extracts were the most sensitive to Klebsiella pneumoniae, with a maximal inhibitory zone of 1 mm, 2 mm, followed by benzene (1.5 mm, 1 mm), ethanol (1 mm, 1 mm), chloroform (0 mm, 1 mm), and aqueous extracts (0.5 mm, 1 mm) (1 mm,0 mm). The results are promising, since the benzene, ethanolic, and chloroform extracts all had significant antibacterial action against the pathogens tested.

V. CONCLUSION

Plants are a source of numerous robust and powerful medications that are utilised medicinally in many nations. Because of the chemical variety, natural products, whether extracts or pure chemicals, present limitless prospects for the creation of novel medications. Due to their ability to produce a variety of compounds with known therapeutic properties, ethnic medicinal plants have been extensively studied as an alternative treatment for diseases to combat the problem of antibiotic resistance, and much attention has been paid to plant extracts and their biologically active compounds. Natural product screening has resulted in the discovery of a plethora of medicinal substances. Higher plants as a source of novel potential medications are still completely unexplored, with only a tiny percentage of species having been exposed to phytochemical study and pharmacological screening. Such screening of numerous natural organic compounds and finding active agents is urgently needed, since effective prediction of lead molecule and drug-like qualities early in the drug discovery process will pay off later in the drug development process.

When compared to regularly used synthetic chemotherapeutic medicines, the plant extractive investigated might be an alternative for those looking for better therapeutic agents from natural sources that are considered to be more efficient with little or no adverse effects. With the presence of tannins, phenols, saponins, steroids, flavinoids, and terpenoids, the study confirmed the traditional use of C. helicacabum for human illnesses and partially explained its usage in herbal medicine as a rich source of phytochemicals. As a result, this plant can be used as a substitute for pharmaceuticals. More research on this plant is needed to extract, characterize, and understand the structure of the plant's bioactive components for commercial medication development.

VI. REFERENCES: -

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