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Research Article

Pharmacognostic and phytochemical evaluation of *Capparis cartilaginea* Decne., leaf: A medicinal plant

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Abstract

Capparis cartilaginea Decne., a member of the Capparidaceae family, is used in traditional medicine to treat various diseases. However, limited pharmacogenetic and phytochemical studies on its leaves exist. This study aims to perform preliminary phytochemical screening, Pharmacognostic, and physicochemical investigations of *Capparis cartilaginea* leaves. Macroscopy, qualitative and quantitative microscopy of leaves, qualitative phytochemical screening and physicochemical analysis were conducted. Macroscopic analysis showed that the leaves are simple, ovate to elliptic with a retuse apex, hooked spines, and a pubescent surface, changing from dark green to glaucous upon drying. Microscopic examination revealed a stomatal index of 10.90 ± 1.0 for the upper epidermis and 6.01 ± 0.7 for the lower epidermis, with anomocytic stomata. Anatomically, the leaves have a single layered epidermis, palisade parenchyma, and well-developed vascular tissues. The methanol and chloroform extractive values were 5.11% and 5.5%, respectively. The moisture content was 5.065%, and the total ash value was 63.57%, indicating good stability and potential need for purification. Phytochemical screening detected alkaloids, glycosides, phenolics, carbohydrates, amino acids, and proteins in the methanol extract, while glycosides were present in the chloroform extract. Fluorescence analysis revealed multiple phytochemicals, supporting the plant's authenticity. These findings confirm *Capparis cartilaginea* leaves as a valuable resource for Pharmacognostic research and potential therapeutic applications.

Keywords: *Capparis cartilaginea;* Herbal drug; Leaf anatomy; Micromorphology; Pharmacognosy; Phytochemistry

Introduction

Medicinal plants are vital in global healthcare, with 80% of the population relying on herbal remedies, mostly in poor and less developed countries **[1-3]**. An estimated 50,000 to 80,000 plants are used for medicinal purposes worldwide **[4]**, with traditional medicine prevalent in countries like India, China, and many African nations **[5]**. However, lack of documentation and quality control hinders their broader acceptance, especially in developed countries **[6]**.

Standardizing plant materials is essential for ensuring their safety, quality, and efficacy. Pharmacognostic studies, including morphological and anatomical analysis, help authenticate plant species, prevent

adulteration, and guarantee reproducible quality of herbal medicines [7, 8]. These methods are crucial for confirming the authenticity and therapeutic properties of medicinal plants [9, 10].

Capparis cartilaginea Decne., a member of the *Capparis* genus in the Capparidaceae family, is recognized for its significant medicinal and nutritional uses in traditional medicine [11, 12]. The genus *Capparis* comprises approximately 150-200 species found in tropical and subtropical regions across the globe [13, 14], with six species documented in Pakistan [15]. *Capparis cartilaginea* is commonly found in regions such as Southwest and East Africa, Palestine, Iraq, and Pakistan, where it is locally known as "gorilmbuk blatter" in Baluchistan [16] and "Lasaf" in Arabian cultures. This plant contains a range of bioactive compounds, including flavonoids, terpenoids, alkaloids, and sterols, which contribute to its wide-ranging therapeutic properties, such as antibacterial, antioxidant, anti-inflammatory, antifungal, antitumor, insecticidal, and cytotoxic effects [17, 18].

Traditionally, the leaves of *Capparis cartilaginea* have been used to treat various ailments, including itching, shortness of breath, head colds, tumors, wounds, and boils [19]. Studies have also reported its antimicrobial and antioxidant activities [20]. The leaves contain bioactive compounds like carbohydrates, saponins, polyphenols (flavonoids and tannins), triterpenes, sterols, amino acids, and proteins, which are believed to contribute to its medicinal properties [20]. Despite its wide use and promising therapeutic effects, no comprehensive pharmacogenetic study has been conducted on *Capparis cartilaginea*.

Therefore, this study aims to evaluate the pharmacognostic parameters of *Capparis cartilaginea* leaves, including macroscopic, microscopic, physicochemical, phytochemicals and fluorescence characteristics. This will provide valuable insights into the identification, quality assurance, and standardization of this medicinal plant, supporting its effective use in herbal medicine.

Materials and Methods

Sample collection: The plant was identified by Dr. Uzma Munir, a plant taxonomist. A herbarium sheet was prepared and deposited at the Herbarium of the Centre for Plant Conservation, University of Karachi, Pakistan, to obtain the voucher specimen (G. H. No: 91552).

Macroscopic analysis

Several macroscopic characteristics, including apex, base, color, margin, shape, size, and surface of the leaf samples, were recorded for identification purposes.

Microscopic analysis

Transverse sections (T.S) of fresh leaves were prepared using a sharp razor blade. Fine sections were mounted on a slide with glycerin and observed under a compound microscope (Thomas Scientific, USA). Quantitative microscopic characteristics, such as stomatal type, stomatal index of the upper and lower epidermis, vein islet numbers, and vein termination numbers, were observed.

Preparation of extracts and preliminary qualitative phytochemical screening

The fresh leaves were washed with distilled water, dried in the shade, and then ground into a fine powder. Five grams of the powder were macerated separately in 50 mL of methanol and chloroform solvents and kept in an incubator at 25°C for five days with continuous shaking. The obtained mixture was then filtered using Whatman filter paper No. 4. After evaporation, the extracted values were calculated. The extracts were used for the preliminary qualitative screening of phytochemicals present in the leaves. Various biochemical tests were performed to detect specific phytochemicals, including Mayer's test for alkaloids, Fehling's test for

carbohydrates, Keller-Killiani's test for glycosides, FeCl3 test for phenolic compounds [21], and Biuret and Ninhydrin tests [22] for proteins and amino acids.

Physiochemical analysis: Physicochemical parameters such as **ash values** (total ash, water soluble ash and acid insoluble ash values) **moisture content** and **fluorescence tests** were performed by standard procedures [23].

Results and Discussion

Morphological analysis of morphological characteristics are essential for pharmacogenetic studies and authenticating the plant in herbal medicine. The results of macroscopic examination of *Capparis cartilaginea* leaf are presented in (Table 1). The shape of the leaf is oval, broad, and fleshy, often terminating in a hooked structure. This hooked apex could serve as a distinguishing feature, potentially providing mechanical support or assisting in the dispersal of the plant. The entire margin and rounded apex and base of the leaf further contribute to its unique macro morphological profile [15].

Microscopic analysis is essential for plant authentication, quality control, and standardization of plant-based drugs [24, 25]. In *Capparis cartilaginea* leaves, the stomatal index was 10.90 ± 1.0 for the upper epidermis and 6.01 ± 0.7 for the lower epidermis, with anomocytic stomata. The vein islet number ranged from 11 to 14, and the vein termination number was 9 ± 2 (Table 2 & Fig. 1). The higher stomatal index on the upper epidermis suggests more active transpiration on the upper surface, possibly an adaptation to environmental conditions. The anomocytic stomata, characterized by a specific arrangement of subsidiary cells, aid in species identification. Additionally, the vein islet and vein termination numbers provide important information on the leaf's vascular structure, crucial for understanding its transport system [26].

Table 1. Macromorphological characters of *Capparis cartilaginea* Decne., leaf

Characters	Observations
Type	Simple
Apex	Retuse or Emarginate with yellowish brown hooked spine
Base	Obtuse
Color	Dark green after drying glaucous
Margin	Entire or wavy
Shape	Ovate, broad elliptic or orbicular
Size	2-6 X 2-6 cm
Surface	Pubescent

Table 2. Quantitative microscopy of *Capparis cartilaginea* Decne., leaf

S. No.	Parameters	Values
1.	Stomatal index: Upper epidermis Lower epidermis	 10.90±1.0 (%) 6.01±0.7 (%)
2.	Vein islet number	11-13 (14) mm^{-2}
3.	Vein termination number	9±2 mm^{-2}
4.	Stomata type	Anomocytic

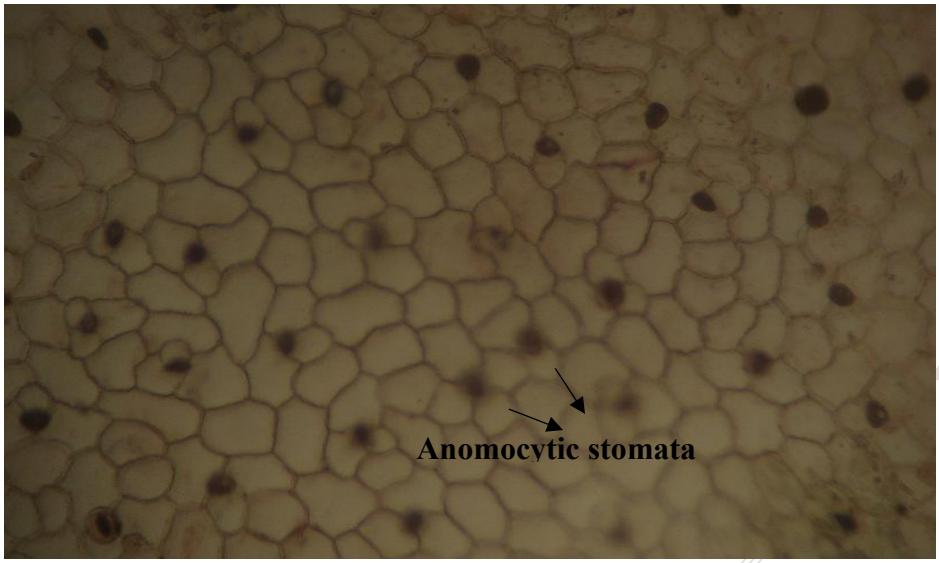

Figure 1. Photomicrograph showing the Transverse Section (T.S) of the leaf lamina across the midrib 100x (Anomocytic stomata)

Leaf anatomy: Transverse section of leaf

Microscopic evaluation is one of the simplest methods used to establish the correct and accurate identity for a plant drug [2]. The transverse section of the *Capparis cartilaginea* leaf revealed a single layered epidermis, palisade parenchyma, spongy parenchyma, xylem, phloem, and a sclerenchymatous pericycle (Fig. 2). The single layered epidermis protects the leaf from water loss and physical damage, while the palisade parenchyma aids in photosynthesis. The spongy parenchyma facilitates gas exchange, and the vascular tissues (xylem and phloem) transport water, nutrients, and sugars, supported by the sclerenchymatous pericycle for structural integrity. The anatomical features observed in the leaf of *Capparis cartilaginea* suggest a well-developed structure that supports both its physiological functions (such as photosynthesis and gas exchange) and its mechanical strength [27]. The anatomical characteristics observed in this study are essential for the identification and quality control of the plant in pharmacognostic evaluations [28].

Extractive values indicate the presence of bioactive compounds in plant material and help assess solvent-specific solubility, which is useful for determining whether a crude drug is exhausted [7, 29]. The extractive values of *Capparis cartilaginea* using methanol and chloroform were 5.11% and 5.5%, respectively (Table 3), suggesting the plant contains moderate levels of both polar (methanol) and non-polar (chloroform) compounds. Methanol extracts polar metabolites, while chloroform extracts non-polar metabolites [30, 31]. These results underscore the plant's potential as a source of diverse bioactive phytochemicals for pharmacological research.

Moisture content affects the stability of crude drugs, with higher levels promoting microbial growth and lower levels improving stability [32]. The air-dried leaf sample of *Capparis cartilaginea* contained 5.065% moisture (Table 3), within the acceptable range of 8-14%, indicating efficient drying and minimal risk of microbial degradation, ensuring safe storage [33-35].

Ash values are key for evaluating the quality, identity, and purity of crude drugs [36, 37,38]. The total ash value of *Capparis*

cartilaginea was 63.57% (Table 3), suggesting significant inorganic content, which could be due to contamination or mineral absorption. The water-soluble ash (4.67%) indicates salts and soluble minerals, while the acid-insoluble ash (3.85%) reflects silica and non-soluble minerals. These values highlight the need for quality assessment and potential purification [39].

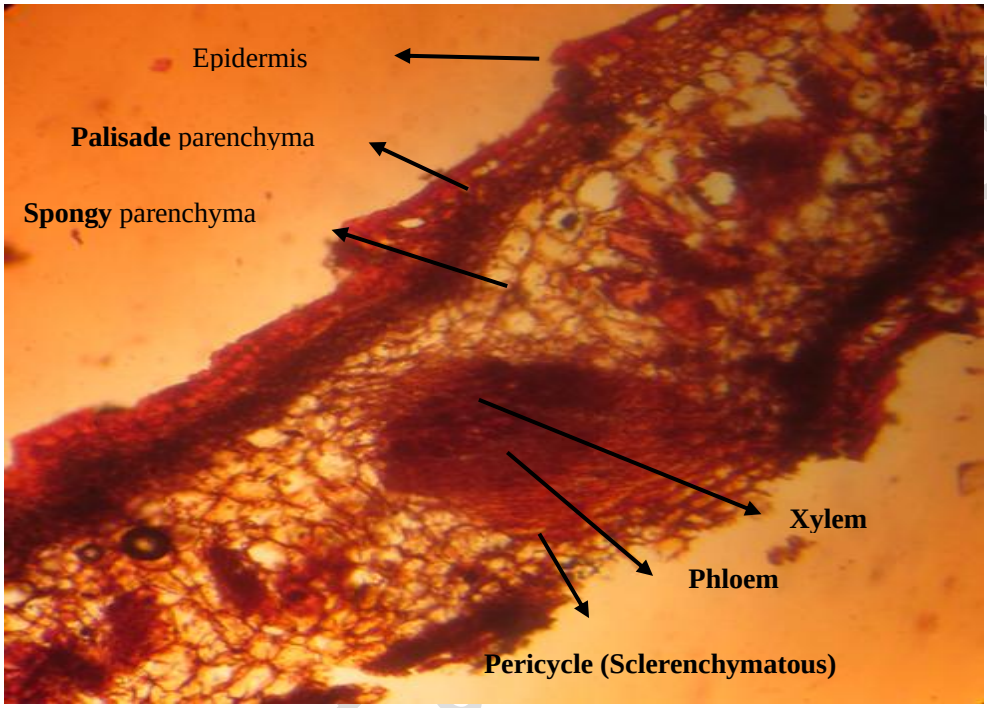

Figure 2. Photomicrograph showing the Transverse Section (T.S.) of the leaf lamina across the midrib 100x

Table 3. Physicochemical analysis of *Capparis cartilaginea* Decne., leaf

S. No.	Quality parameters	% Composition	
1	Extractive Value	**Methanol**	**Chloroform**
		5.11±0.73	5.5±0.9
2	Moisture Content	5.065±0.20	
3	Ash value		
	a. Total Ash Value	63.57±0.29	
	b. Water Soluble ash	4.67±0.37	
	c. Acid insoluble Ash	3.85±0.98	

Percentage composition values are presented as Mean ± SEM, $n = 3$

Phytochemical screening of *Capparis cartilaginea* leaf extract identified bioactive compounds to validate its traditional uses and support future research [40]. The methanolic extract contained alkaloids, glycosides, phenolic compounds, carbohydrates, amino acids, and proteins, while the chloroform extract only contained glycosides (Table 4). This suggests methanol is more effective for extracting a broader range of bioactive compounds, particularly polar ones [30, 31]. The findings, excluding alkaloids, align with those from Abyan, Yemen [41], with variations likely due to environmental factors [42].

Table 4. Qualitative phytochemical analysis of *Capparis cartilaginea* Decne., leaf

S. No.	Phytochemical constituents	Inference	
		Methanol	Chloroform
1	Alkaloids (Mayer's Test)	+	-
2	Glycosides (Keller Killiani's Test)	+	+
3	Phenolic Compounds ($FeCl_3$ Test)	+	-
4	Carbohydrates (Fehling's Test)	+	-
5	Amino acids (Ninhydrin Test)	+	-
6	Proteins (Biuret Test)	+	-

Key: Positive (+) = Present; Negative (-) = Absent

Fluorescence analysis was performed to assess the leaf powder as a crude drug, aiding in plant identification and quality control. Significant color changes were observed under visible and UV light when the dried leaf powder was treated with various solvents (Table 5). These variations indicate the presence of multiple phytochemicals and suggest the potential of fluorescence analysis in detecting adulteration in crude drug forms [43-45].

Table 5. Fluorescence analysis of dried leaf powder of *Capparis cartilaginea* Decne

S. No.	Reagents	Visible light	UV 366 nm
1	d H2O	Green	Grey
2	75% Ethanol	Light Green	Dark Green
3	1N HCl	Light Brown	Dark Brown
4	1:1 H2SO4	Dark Brown	Black
5	5% FeCl3	Dark green	Jet black
6	10% NaOH	Yellowish Green	Greyish Green

Conclusion

The comprehensive macroscopic, microscopic, and phytochemical analyses of *Capparis cartilaginea* leave provide valuable insights into its morphological, anatomical, and chemical properties. The distinctive leaf shape, pubescent surface, and unique apex with hooked spines offer clear identification features. Microscopic parameters, such as the stomatal index, vein structure, and stomata type, contribute to understanding the plant's environmental adaptation and transport

system. Anatomically, the presence of epidermis, palisade parenchyma, and well-developed vascular tissues supports its physiological functions. The extractive values indicate that both polar and non-polar compounds are present, highlighting the plant's potential as a source of bioactive metabolites. Additionally, the low moisture content and high total ash value suggest that the plant is stable for storage and may require purification to ensure purity. Phytochemical screening confirmed the presence of key bioactive compounds, particularly alkaloids and phenolics, which are known for their pharmacological properties. Fluorescence analysis further supports the plant's authenticity and can be used for quality control. These findings underscore the importance of *Capparis cartilaginea* in pharmacognosy and its potential for further therapeutic applications.

Author`s contribution

Conceived, designed and performed the experiments: U Munir, Analyzed the data: S Mansuri, contributed reagents/ materials/ analysis tools: A Perveen, Wrote the paper: I Jamil.

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