Review Article

Pharmacognostic and Pharmacological Perspective of *Hibiscus hispidissimus*: A Review

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ABSTRACT

Hibiscus hispidissimus (Malvaceae) is an ethnomedicinal plant widely used in traditional healthcare systems of India, particularly for the management of liver disorders, inflammation, and digestive ailments; however, despite its traditional relevance, the available scientific data remain fragmented. The present review aims to systematically compile and critically evaluate its ethnomedicinal uses, pharmacognostic characteristics, phytochemical composition, chromatographic profiling, and pharmacological activities. Relevant literature was collected from various scientific databases and analyzed to summarize botanical descriptions, pharmacognostic standards (including macroscopic, microscopic, and physicochemical parameters), phytochemical investigations such as HPTLC fingerprinting, and experimentally validated pharmacological studies. The findings reveal that the plant is rich in bioactive constituents including phenolics, flavonoids, triterpenoids, and phytosterols such as β-sitosterol. Pharmacognostic evaluation identified distinctive diagnostic features, including stellate trichomes and calcium oxalate crystals, while chromatographic profiling confirmed the presence of diverse secondary metabolites. Experimental studies demonstrated significant hepatoprotective activity, evidenced by reductions in liver enzyme markers (SGOT, SGPT, ALP, and bilirubin) along with histological restoration in hepatotoxic models. Additionally, the plant exhibited notable antioxidant and potential anti-inflammatory activities, largely attributed to its high phenolic and flavonoid content, and acute toxicity studies indicated a favorable safety profile at therapeutic doses. Overall, the compiled evidence supports the traditional use of *Hibiscus hispidissimus*, particularly in liver-related and oxidative stress-associated disorders; however, further research focusing on molecular mechanisms, long-term toxicity, and clinical validation is essential for its development into standardized phytotherapeutic agents.

Keywords: *Hibiscus hispidissimus*, Ethnomedicine, Pharmacognosy, Phytochemistry, Hepatoprotective, Antioxidant.

1. INTRODUCTION

The role of medicinal plants in primary healthcare remains crucial in most parts of the world particularly in developing countries where conventional medical practices are still largely used[1,2]. The World Health Organization recognizes the usefulness of plant-based therapy due to its easy availability, cultural acceptance, and overall relationship with fewer side-effects[1]. India as a country with rich bio-diversity and deep-rooted traditional healthcare system like Ayurveda, Siddha and folk medicine is a great source of medicinal plants with different pharmacological activities.[3]

The ethnomedicinally important plant, *Hibiscus hispidissimus*, is a species of the family Malvaceae commonly used in traditional Indian healthcare systems and is found in the Western Ghats area especially in the Western ghats[4]. The various components of the plant have been used traditionally in the treatment of liver diseases, inflammation, helminthic infections, and other digestive disorders[4,5,6]. Liver diseases have remained a major health problem in the world and herbal medicine is widely used in hepatoprotection, which highlights the role of the plants in the management of liver diseases in the past [7,8].

Although it is highly used traditionally, *Hibiscus hispidissimus* has not been sufficiently reported in the context of pharmacognostic standards, physicochemical properties and detailed phytochemical profiling, limiting its use in official pharmacopeias[9,10]. The quality, safety and therapeutic efficacy of herbal medicines can only be guaranteed by proper standardization and authentication of herbal medicines by systematic pharmacognostic and phytochemical assessment[10,11].

Initial studies indicate that *H. hispidissimus* contains a lot of bioactive phytochemicals, such as phenolics, flavonoids, triterpenoids, and phytosterols, which have been extensively known to be antioxidant and hepatoprotective[12,13,14.] Since oxidative stress is a significant cause of liver damage and inflammatory diseases, medicinal plants rich in antioxidant compounds have been regarded as useful therapeutic agents[13,15]. It is not a limitation of this potential, but the existing scientific data on *H. hispidissimus* is scattered and few, which is why more systematic studies are necessary.

This review therefore aims at summarizing and critically reviewing the available literature on ethnomedicinal significance, botanical and pharmacognostic properties, phytochemical composition, chromatographic fingerprinting, and pharmacological properties of *Hibiscus hispidissimus.* In this way, it will seek to have a scientific explanation of its traditional uses and also highlight gaps that can take future studies.

2. PLANT PROFILE

2.1 Taxonomical Classification [16]

- Kingdom: Plantae
- Phylum: Tracheophyta
- Class: Magnoliopsida
- Order: Malvales
- Family: *Malvaceae*
- Genus: Hibiscus
- Species: *Hibiscus hispidissimus*

2.2 Vernacular names: -[9,17]

- Sanskrit – Sathambasthi
- Malayalam – Uppanacham
- Kannada – Kairpuli, Betta bende
- Telugu – Adavi gogu and Konda gogu.
- Hindi – van gurhal
- Marathi – kateri bhendi

2.3 Synonym: -[18]

Hibiscus furcatus DC. Non Wild and *Hibiscus aculeatus* Roxb. Non Walter

2.4 Geographical Distribution

Hibiscus hispidissimus. is a tropical plant that is mainly spread in the Indian subcontinent up to the China and Indo-China regions, and this implies that the plant is adapted to warm and humid climatic conditions [5]. The fact that it is found in a very broad geographical belt indicates its ecological adaptability and suitability to exist in various tropical environments especially in areas with heavy rainfall and moderate temperatures [9].

In India, the plant is commonly reported in biodiversity hotspots like the Western Ghats, comprising of states like Kerala, Karnataka and Maharashtra. These areas also offer the best environmental factors such as thick vegetation, fertile soil and constant moisture that promote the growth and reproduction of the species [5]. The Western Ghats is a global biodiversity hot spot and a key point of distribution of this natural habitat [9].

Hibiscus hispidissimus is also present in other neighboring countries like Sri Lanka, Myanmar, Thailand, and some parts of southern China, and this shows that it is prevalent in South and Southeast Asia [9]. Such extensive distribution in the region indicates that the species has been adapted to the monsoon-controlled climatic conditions and is capable of thriving in the forest edges as well as semi-wild areas [9].

The plant is normally found in wet tropical forests, hilly areas, and open scrublands, which are also likely to be found in disturbed habitats. The fact that it prefers humid climate and has sufficient water and sunlight also explains why it is concentrated in tropical and subtropical areas [5,9]. In general, the ecological adaptability and relevance of *Hibiscus hispidissimus* in the ecological context of the tropical flora is emphasized by the geographical distribution of the plant.

Figure 1: Global distribution of *Hibiscus hispidissimus*. Green: Native range. Purple: Introduced and naturalized regions. Source: POWO/Kew Science.

2.5 Ethnomedicinal and Traditional Uses

Plants that are traditionally medicinal have been employed in the prevention and cure of several diseases. One of the medicinal plants which have not yet been explored is *Hibiscus hispidissimus*, which is spread in the Western Ghats of India, as well as in China, Thailand, Sri Lanka, etc. It is commonly referred to as Comfort root, or Hill hemp bendy. The colloquialism is Uppanacham (Malayalam) and Sathambasthi (Sanskrit). It is employed as medicine and food. The plant is traditionally used as an anthelmintic, antibacterial, antioxidant, anti-inflammatory,antidiabetic, anti-arthritic, diuretic, nephroprotective and hepatoprotective by tribal healers [4,9].

Hibiscus hispidissimus has a variety of applications in native and folk medicine in India, especially in tribal and rural populations of the Western Ghats, in the treatment of different diseases [4,9]. The traditional healers mostly use the leaves and roots of the plant in the treatment of hepatic diseases, inflammatory diseases, and parasitism [4].

The leaves are also normally employed in the management of liver diseases like jaundice and hepatitis in the form of decoctions or cooked meals and are thought to enhance digestion and liver performance [4,9]. The vegetable consumption of the slightly acidic leaves also has been considered as a vegetable and is traditionally considered as having anthelmintic properties [4].

The extensive use of *H. hispidissimus* in traditional medicine demonstrates the significance of the plant in medicine and offers a good ethnopharmacological foundation to the scientific study and pharmacological validation of the plant[4,9].

2.6 Pharmacognostic Evaluation

The pharmacognostic analysis of *Hibiscus hispidissimus.* is done by careful scrutiny of the macroscopic and microscopic

features of the herb to guarantee the adequate identification and standardization of the herb. Macroscopically, the plant has hairy (hispid) stems and leaves, simple and alternate leaves and typical hibiscus-like flowers. Diagnostic characteristics with the microscope are the presence of multicellular covering trichomes, presence of mucilage-containing cells, and well-developed vascular bundles. Powder microscopy also shows the traces of epidermal cells, trichomes, xylem vessels, and calcium oxalate crystals, which are also significant in the identification and authentication of crude drugs [9].

Along with morphological and anatomical analyses, physicochemical data including ash values, extractive values, and moisture content is determined to determine purity and quality. Early phytochemical screening of *Hibiscus hispidissimus* has shown the existence of bioactive compounds such as flavonoids, tannins, phenolic compounds, and mucilage, which make the plant have therapeutic value. This phytochemical and pharmacognostic standards play a crucial role in the growth of quality control profiles and to prevent adulteration in herbal preparations [1,6].

2.7 Macroscopic (Organoleptic) Evaluation

Macroscopic observation of *H. hispidissimus* indicates some characteristic morphological features which can be used in preliminary identification. The leaves are simple, alternate, broadly ovate and palmately lobed (35 lobes) with cordate base and serrated margins and about 612 cm in length [9]. The leaf surface is rough because of the existence of stiff hair-like structures, and the lower surface is pubescent giving the surface a characteristic feel and look.

It has a cylindrical, woody, greenish-brown or reddish stem, hooked prickles and dense stellate trichomes, which is a defining characteristic [9]. The parts of the plants have an organoleptic odor and sour taste, which can be explained by the presence of organic acids and phenolic compounds [19].

Macroscopic analysis is important in the field and market identification of crude drugs and the initial stage in the pharmacognostic standardization [20].

Figure 2: Flower of *Hibiscus hispidissimus*

Figure 3: Leaves of *Hibiscus hispidissimus*

2.8 Microscopic Evaluation

Microscopic observation of the transverse section of the leaf reveals that there is only one layer of the upper and lower epidermis with thick cuticle. Both the epidermal layers have large multicellular stellate trichomes which is a characteristic feature of the species [9]. The mesophyll is further differentiated into palisade parenchyma and spongy parenchyma where the palisade cells contain chloroplasts and therefore, they are active in photosynthesis.

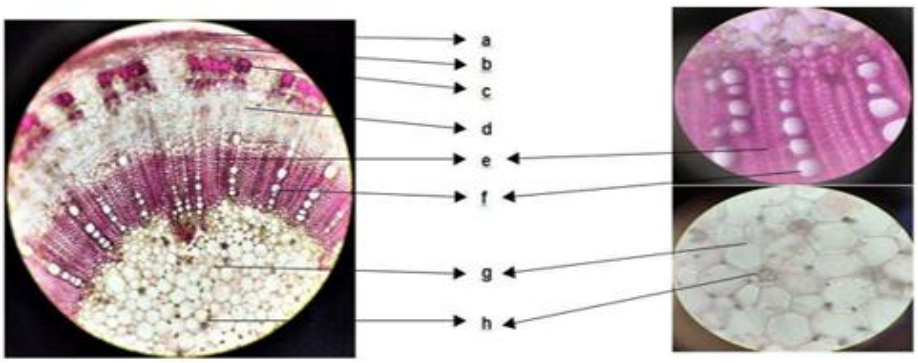

Figure 4 (a): T.S of *Hibiscus hispidissimus* stem stained with safranin observed under magnification 10x and 40x respectively. a-epidermis, b-cortex, c-pericyclic fibers, d-phloem, e- medullary rays, f- xylem, g-pith, h-rosette of calcium oxalate crystals.

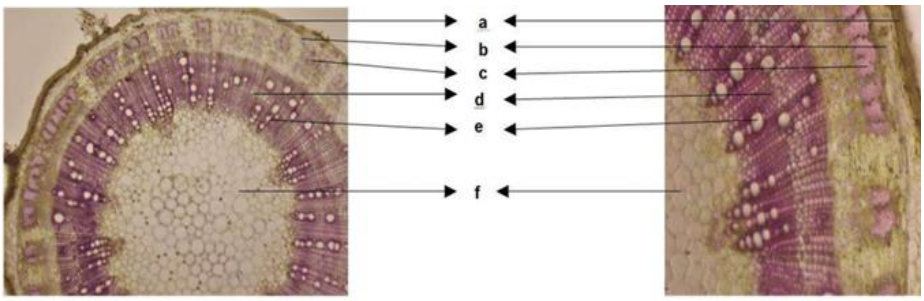

Figure 5 (b): T.S of *Hibiscus hispidissimus* stem stained with phloroglucinol-HCl reagent observed under magnification 4x and10x respectively. a-Epidermis, b-Cortex, c-Lignified pericyclic fibers, d-Medullary rays, e-Xylem, f-Pith

A conjoint and collateral vascular bundle constitute the vascular system, which is encircled by parenchymatous tissues. The calcium oxalate crystals are seen scattered in the mesophyll cells mostly in the form of prismatic crystals, which is considered an important diagnostic microscopic feature [9,21].

Transverse stem section has a clear epidermis, which is succeeded by chlorenchymatous hypodermis, parenchymatous cortex, and a prominent secondary vascular region consisting of phloem and xylem components[9]. The xylem has lignified fibers, vessels that have spiral and pitted thickenings and the central pith has thin-walled parenchymatous cells.

2.9 Powder Microscopy

Dried leaf and stem powder microscopy shows that there are lignified xylem vessels, fibers, trichomes, parenchyma cell, starch grains, and calcium oxalate crystals, all of which are diagnostic features [9]. The stellate trichomes especially are not lost after powdering and serve as an excellent identifying character of *H. hispidissimus.* Powder analysis is particularly applicable in the cases where the drug is sold in powder form, and the macroscopic identification is not possible anymore [22].

3. SIGNIFICANCE OF PHARMACOGNOSTIC PARAMETERS

Macroscopic, microscopic, and powder properties give a detailed framework of the authentication and quality assurance of *H. hispidissimus* as a crude herbal drug [23]. These diagnostic parameters are necessary to guarantee the reproducibility, safety and efficacy of herbal preparations prepared using this plant [24].

It is also through pharmacognostic standardization that medicinal plants can be included in official pharmacopeias and used rationally in the development of herbal drugs [25].

4. PHYTOCHEMICAL PROFILE

The role of phytochemical research is crucial in matching the traditional medicinal applications of plants with their therapeutic potential because secondary metabolites are the major cause of biological activity [26]. As it is the case of *Hibiscus hispidissimus.,* systematic phytochemical screening and chromatographic analysis has provided evidence that it contains a variety of bioactive constituents which justifies its ethnomedicinal uses.

There were no or traces of carbohydrates and proteins, and phenols and flavonoid were more abundant in leaf extracts than in stem extracts, indicating organ-specific accumulation of secondary metabolites [27]. These differences in the distribution of phytochemicals are usually affected by the metabolic activity and environmental exposure, especially light and oxidative stress [19,28].

4.1 Quantitative Phytochemical Estimation

H. hispidissimus extracts were analyzed quantitatively and total phenolic content (TPC) and total flavonoid content (TFC) were found to be significantly higher in leaf extract than in stem extracts [12]. High level of phenolic is directly proportional to antioxidant potential because phenolic compounds are famous hydrogen donors and free-radical scavengers [14,29].

Flavonoids form a significant group of polyphenols, and they play roles in anti-inflammatory, hepatoprotective, and cytoprotective properties by regulating oxidative stress and cellular signaling pathways [14,30]. The aerial use of leaves by traditional medicine systems is supported by the fact that these compounds are predominant in leaves quantitatively.

4.2 Phytosterols and Triterpenoids

The existence of 20)-sitosterol, a famous phytosterol, as a marker compound in *H. hispidissimus* has been confirmed in studies based on chromatography [12]. 20)-Sitosterol was detected in greater amounts in stem extracts than in leaves, which suggests tissue-specific biosynthesis.

Phytosterols and triterpenoids are also known to have hepatoprotective, anti-inflammatory, immunomodulatory, and antioxidant effects, which are a strong indication of the use of the plant in liver diseases [7,8,31]. They also have the membrane-stabilizing effect which also aids in the hepatocellular protection against the damage caused by toxins [30].

5. CHROMATOGRAPHIC FINGERPRINTING AND PHYTOCHEMICAL DIVERSITY

To determine a phytochemical fingerprint profile of the leaves and stems of *H. hispidissimus,* high-performance thin-layer chromatography (HPTLC) analysis has been used [27]. The presence of different classes of secondary metabolites with different polarity and UV absorbing properties is shown by distinct chromatographic bands at

various wavelengths (254 nm, 366 nm and post-derivatization).

Chromatographic fingerprinting is also useful in quality control and standardization as well as maintaining batch-to-batch consistency of herbal raw materials and formulations [24,25].

5.1 Correlation of Phytochemicals with Pharmacological Activity

The occurrence of phenolics, flavonoids, saponins and phytosterols in *H. hispidissimus* gives it a solid scientific ground in its antioxidant and hepatoprotective properties as evidenced in experimental studies [27]. The compounds work synergistically to counteract free radicals, prevent lipid peroxidation and promote endogenous antioxidant defense systems [13,15,28].

These phytochemical pharmacological relationships are fundamental to the rational design of standardized herbal therapeutics and confirm the ethnomedicinal pertinence of the plant [23,20].

6. PHARMACOLOGICAL ACTIVITIES

Experimental studies have been conducted to investigate the pharmacological potential of *Hibiscus hispidissimus.* and support its traditional medicinal assertions. Its biological activities are mostly explained by the high content of phytochemicals, especially phenolics, flavonoids, phytosterols, and triterpenoids [12,14,29,30].

6.1 Hepatoprotective Activity

The pharmacological activity of *H. hispidissimus* that has been studied the most is hepatoprotective activity. The plant ethanolic extracts have shown considerable protective properties against hepatotoxicity caused by paracetamol and carbon tetrachloride in experimental animal models [27]. The extract treatment led to a significant decrease in serum liver marker enzymes including SGOT, SGPT, ALP and bilirubin which signifies reinstatement of hepatic functional integrity [27,7].

Histopathological analysis also showed hepatocyte regeneration and liver architecture normalization of treated groups, which were similar to the standard hepatoprotective drug silymarin [8]. The hepatoprotective effect is explained by the existence of flavonoids and 2-sitosterol that stabilize the hepatocellular membranes and suppress lipid peroxidation [14,7,30].

6.2 Antioxidant Activity

In vitro free radical scavenging models have been used to assess the antioxidant potential of *H. hispidissimus,* which included DPPH and lipid peroxidation models, and the plant extract showed great antioxidant potential [27,13]. This effect is associated with high content of total phenolic and flavonoid, especially in the leaf extracts [12,29.]

Phenolic compounds are hydrogen or electron donors, neutralizing reactive oxygen species, and stopping oxidative cellular damage [13,15]. The antioxidant effect is important in alleviating oxidative stress-related diseases, such as liver diseases, thus supplementing the hepatoprotective effect of the plant [14,29].

6.3 Anti-inflammatory Activity

Though there is lack of experimental research, the bioactive constituents including flavonoids, triterpenoids and phytosterols indicate significant anti-inflammatory activity of *H. hispidissimus* [14,30]. These compounds have been known to suppress pro-inflammatory mediators and regulate inflammatory signaling pathways thus suppressing tissue inflammation [30,31].

The use of the plant as a traditional medicine in the treatment of swellings and inflammatory disorders also adds credence to the anti-inflammatory applicability of the plant [4,5]. Nonetheless, in vivo and molecular systematic studies are needed to define the ultimate anti-inflammatory processes.

6.4 Anthelmintic and Digestive Activity

Ethnomedicinal Ethnomedicinal records show the application of *H. hispidissimus* leaves as an anthelmintic and digestive aid, especially when taken orally after cooking [4,6]. The existence of saponins and glycosides could also be a factor in this activity since these substances are also known to interfere with helminth membranes and enhance gastrointestinal motility [32,26].

Although the traditional evidence is compelling, there is a lack of scientific validation of the anthelmintic efficacy in controlled pharmacological studies.

7. SAFETY AND TOXICOLOGICAL PROFILE

Investigations of acute oral toxicity using OECD guideline 423 have shown that the ethanolic extracts of *H. hispidissimus* are reasonably safe at therapeutic levels and no observable adverse behavioral changes or death in test animals [27,2]. Such results endorse the folk medicine utilization of the plant.

However, the lack of chronic toxicity, reproductive toxicity, and clinical safety data indicates that there is a necessity of conducting a thorough toxicological assessment prior to long-term therapeutic use [23,25].

8. FUTURE PERSPECTIVES

Even though scientific evidence supporting the traditional use of *Hibiscus hispidissimus* is scientifically available, the available information is mainly preclinical and exploratory. The future research should be directed towards the isolation, characterization, and quantification of bioactive phytoconstituents with the help of more sophisticated analytical methods, and clarification of their exact molecular mechanisms of action in hepatoprotection, antioxidant defense, and the regulation of inflammation. Extensive toxicological tests, such as long-term safety and pharmacokinetic trials, are needed to determine dosage and therapeutic margins. Besides, evidence-based phytotherapeutic practice will require well-designed clinical

trials and the development of standardized herbal preparations to translate traditional knowledge into evidence-based practice.

CONCLUSION

The paper is a comprehensive review of the ethnomedicinal importance, pharmacognostic criteria, phytochemical profile, and pharmacological actions of *Hibiscus hispidissimus*. Its use has been supported by experimental studies especially in the hepatic and oxidative stress-related disorders, which are mostly explained by the existence of phenolics, flavonoids, triterpenoids, and phytosterols. There are scientific parameters of authentication and quality control based on established pharmacognostic and chromatographic parameters. Although the plant has shown potential therapeutic effects and a good initial safety profile, additional mechanistic, toxicological, and clinical research is required to justify its use in the modern herbal medicine and drug development.

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