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Review Article

Pharmacognostical and Phytochemical Studies of *Huberantha senjiana* Leaf

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ABSTRACT

Traditional medical systems have relied heavily on medicinal plants, which also supply bioactive ingredients for contemporary drug development. The goal of this study was to assess the pharmacognocal traits and initial phytochemical profile of the leaves of the rare plant *Huberantha senjiana* (family: Annonaceae), which is native to Tamil Nadu, India's Eastern Ghats. Pharmacognostical studies included physicochemical factors, particle properties, and microscopic and macroscopic analysis. To find out whether the main secondary metabolites were present, phytochemical screening of several solvent extracts was done. As the phytochemical research verified the existence of alkaloids, flavonoids, tannins, phenols, glycosides, and terpenoids, suggesting the plant's therapeutic potential, the study also identified unique pharmacognostical traits that are helpful for identification and standardisation. The traditional usage of H. senjiana are supported by our findings, which also serve as a foundation for more pharmacological research.

INTRODUCTION

Due to the fact that around 80% of the world's population relies on traditional herbal remedies for primary healthcare, plants have been widely employed as sources of medicine since ancient times [1]. Pharmacognostical investigations are crucial for accurately identifying and standardising crude pharmaceuticals since they entail the methodical examination of the morphological, anatomical, and chemical properties of medicinal plants [2]. Similarly, phytochemical analyses are essential for identifying the bioactive substances that exhibit therapeutic effects, thus bridging the gap between conventional wisdom and contemporary drug discovery [3].

Huberantha senjiana is a recently described species from Tamil Nadu, India's Eastern Ghats

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that is a member of the Annonaceae family [4]. Numerous species of the Annonaceae family include antibacterial, anticancer, anti-inflammatory, and antioxidant properties, making them well-known for their therapeutic significance [5]. Nevertheless, there are still few scientific findings on H. senjiana's pharmacognostical and phytochemical properties. Therefore, the purpose of this work was to promote its ethnomedicinal significance and future pharmacological research by establishing baseline pharmacognostical standards and conducting preliminary phytochemical screening of its leaf extracts.

2. Ethnopharmacological Relevance

Annonaceae members have been used in traditional medicine systems in Asia and Africa to treat wounds, fever, infections, and digestive issues [5]. Despite being a relatively recent species with little ethnobotanical record, allied genera like Polyalthia and Annona are wellknown for their antioxidant, analgesic, and antibacterial qualities [6]. Given this ethnopharmacological link, it is possible that H. senjiana contains bioactive substances with potential medical uses.

3. Types of Phytochemicals and Their Categories

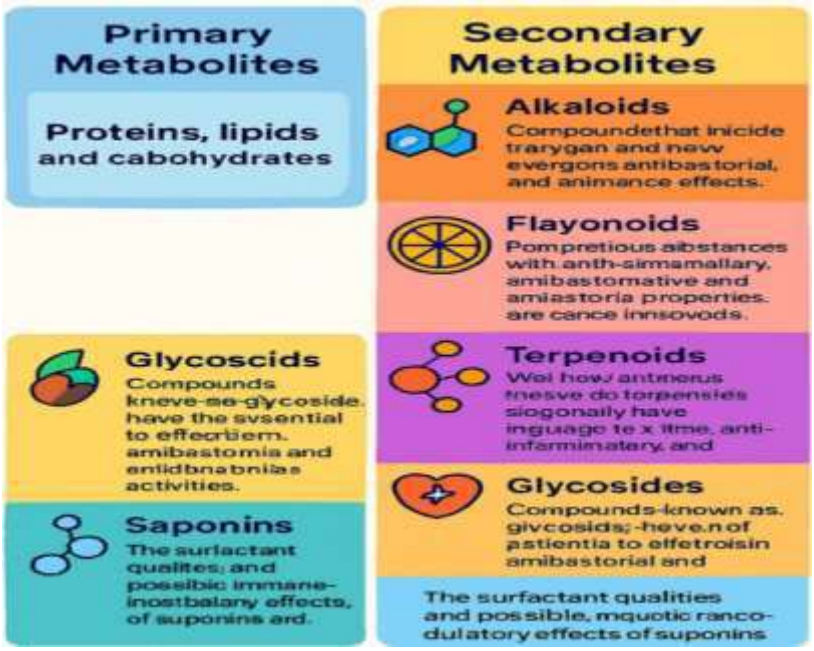

Fig.1 Types of Phytochemicals

In general, phytochemicals can be divided into two categories: primary metabolites, which are necessary for plant growth and include proteins, lipids, and carbohydrates, and secondary metabolites, which frequently offer therapeutic and adaptation benefits [7]. Among the primary types of secondary metabolites found in H. senjiana are:

- Alkaloids: Compounds that include nitrogen and have analgesic, antibacterial, and anticancer effects.
- Flavonoids: Polyphenolic substances with anti-inflammatory, cardioprotective, and antioxidant properties are called flavonoids.
- Tannins: Astringent substances having antibacterial, anti-diarrheal, and wound-healing properties are called tannins.

- Terpenoids: Volatile substances known as terpenoids frequently have hepatoprotective, anti-inflammatory, and anti-cancer properties.
- Glycosides: Compounds known as glycosides have the potential to affect both antibacterial and cardiovascular activities.
- Saponins: The surfactant qualities and possible immune-modulatory effects of saponins are well-known.

The medicinal significance of the plant is highlighted by these categories, which also support the necessity of a thorough phytochemical analysis.

4. MATERIALS AND METHODS

4.1 Collection and Authentication

During the blooming season, fresh leaves of *Huberantha senjiana* were gathered from Senji Hills in Tamil Nadu's Villupuram District. A taxonomist verified the plant material, and a voucher specimen was placed in the herbarium for future use.

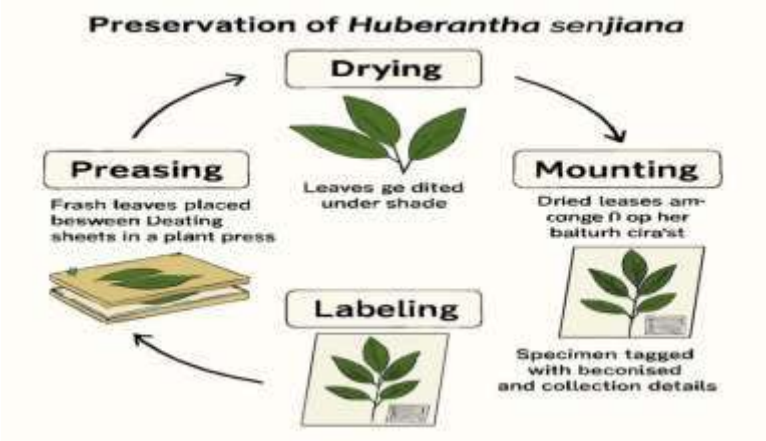

Fig.2 Preservation of *Huberantha senjiana*

4.2 Pharmacognostical Studies

Using macroscopic examination, the size, shape, margin, texture, colour, odour, and taste of both fresh and dried leaves were assessed. To observe anatomical features including the epidermis, stomata, trichomes, mesophyll, vascular bundles, and crystal inclusions, microscopic analyses were performed on transverse sections of the leaf stained with safranin and iodine. To find diagnostic pieces including fibres, vessels, trichomes, and calcium oxalate crystals, powder microscopy was used on dried leaf powder.

4.3 Physicochemical Parameters

Parameters including total ash, water-soluble ash, acid-insoluble ash, loss on drying, and extractive values with alcohol and water were measured using standard procedures in accordance with WHO recommendations [6].

4.4 Phytochemical Screening

Petroleum ether, chloroform, ethanol, and water were used as successive extraction solvents with increasing polarity. Alkaloids, flavonoids, tannins, phenols, steroids, terpenoids, glycosides, and saponins were all detected by preliminary phytochemical screening carried out in accordance with conventional procedures [7].

5. Pharmacognostical Features

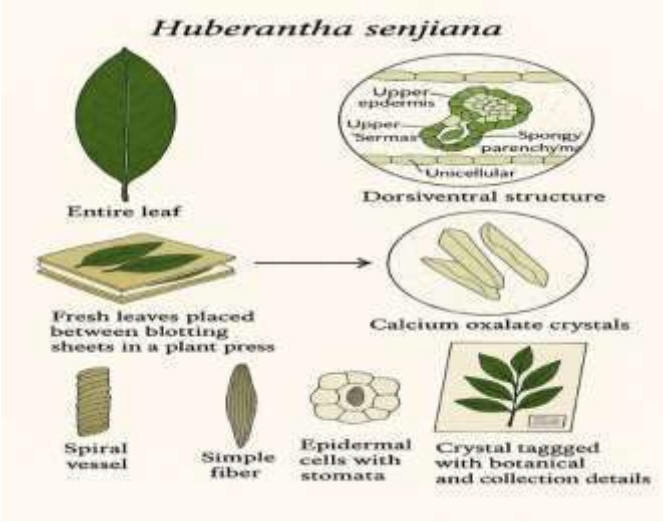

Fig.3 *Huberantha senjiana*

H. senjiana's leaves were 8–12 cm long, lanceolate, simple, and glabrous with an acute apex and whole border. The lower surface was a lighter shade of green, whereas the upper surface seemed smooth and dark green. When examined under a microscope, the leaf showed a dorsiventral structure with a noticeable upper and bottom epidermis. Mostly found on the lower epidermis were unicellular non-glandular trichomes and paracytic stomata. Palisade and spongy parenchyma were the outcomes of the mesophyll's differentiation, while parenchymatous sheath cells encircled collateral vascular bundles. Additionally, crystals of calcium oxalate were found as diagnostic indicators. By revealing pieces of spiral arteries, simple fibres, stomata-containing epidermal cells, and crystal clusters, powder microscopy verified its anatomical identity.

6. Results and Outcomes

6.1 Physicochemical Analysis

Water-soluble and acid-insoluble ash had respective values of 3.1% and 2.4%, while the overall ash value was 8.2%. Drying loss was within pharmacopoeial bounds, suggesting low moisture content and fewer potential microbiological contaminants. Compared to the water-soluble fraction, the alcohol-soluble extractive value was greater, indicating the presence of more alcohol-soluble phytoconstituents, including flavonoids and alkaloids.

6.2 Phytochemical Screening

Alkaloids, flavonoids, tannins, phenolic compounds, glycosides, terpenoids, and saponins were found as a result of preliminary phytochemical screening. In most extracts, steroids were not present. Antioxidant, antibacterial, anti-inflammatory, and anticancer characteristics are just a few of the many pharmacological activities that these secondary metabolites are known for [8].

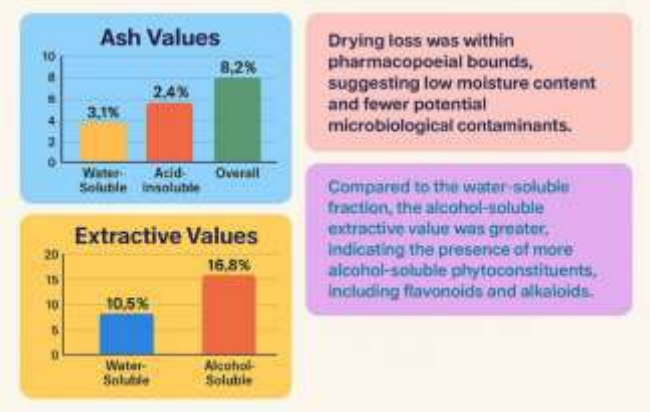

Fig.4 Physicochemical Analysis

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7. Implications of Pharmacognostical and Phytochemical Studies

Pharmacognostical investigations offer essential diagnostic characteristics for accurately identifying crude medications, which is essential for maintaining quality control and avoiding adulteration [2]. In H. senjiana, the presence of calcium oxalate crystals, unicellular trichomes, and paracytic stomata can all be used as trustworthy microscopic markers. Its safe usage as a herbal medication is further supported by the observed physicochemical values, which are within WHO-recommended limits for crude plant materials [6]. The presence of alkaloids, flavonoids, and tannins in the phytochemical profile of H. senjiana leaves is in line with bioactive substances found in other Annonaceae family members [5]. Numerous biological actions are attributed to these metabolites: flavonoids have potent antioxidant activity, tannins are recognised for their astringent and anti-inflammatory qualities, and alkaloids have antibacterial and anticancer effects [8]. Thus, H. senjiana's phytochemical makeup supports its potential as a source of chemicals having pharmacological activity.

8. Future Scope

The current research on *Huberantha senjiana* lays the groundwork for future investigations. Future investigations ought to concentrate on:

- Individual bioactive compound isolation and characterisation by the use of spectroscopic and chromatographic methods.
- Validation of antibacterial, antioxidant, anticancer, and anti-inflammatory properties by in vitro and in vivo pharmacological tests.
- Assessment of toxicity to guarantee safety for therapeutic application.
- Creation of standardised herbal products through formulation using extracts from H.
- senjiana.
- Measures for conservation, since sustainable harvesting is essential for H. senjiana, an endemic species with a restricted range.

In modern medicine, H. senjiana may become a new source of natural drug leads if these guidelines are followed.

CONCLUSION

Future pharmacological research, quality control, and authentication can all benefit from the baseline data that the current pharmacognostical and phytochemical analyses of *Huberantha senjiana* leaves provide. Unique macroscopic and microscopic characteristics such calcium oxalate crystals, unicellular trichomes, and paracytic stomata were highlighted in the study. These characteristics could be used as diagnostic markers to stop the adulteration and misidentification of unrefined herbal medications [10]. With physicochemical properties falling below WHO-recommended bounds, H. senjiana was validated as a suitable herbal resource [11]. Alkaloids, flavonoids, tannins, glycosides, phenols, and terpenoids—secondary metabolites linked to a variety of biological activities, such as antimicrobial, antioxidant, antiinflammatory, and anticancer effects—were confirmed by preliminary phytochemical screening [12,13]. These results are in line with studies on other Annonaceae family members, which are known to contain a large number of acetogenins, alkaloids, and flavonoids with important pharmacological potential [14,15].

As an endemic species with a restricted range in the Eastern Ghats, H. senjiana requires conservation measures and sustainable use to avoid overexploitation. Using cutting-edge chromatographic and spectroscopic techniques, future studies should focus on the separation, purification, and characterisation of its bioactive components. Its therapeutic potential will also need to be confirmed by pharmacological assessments conducted in vitro, in vivo, and in clinical trials [16]. Its bioactive compounds may be much more applicable if contemporary techniques like metabolomics, molecular docking, and nanotechnology-based drug delivery systems are integrated [17,18].

In conclusion, this work highlights the promise of *Huberantha senjiana* as a source of new therapeutic leads and provides the first pharmacognostical and phytochemical baseline for the plant. With more investigation and verification, this species could play a major role in the creation of new-generation phytopharmaceuticals and standardised herbal formulations.

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