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PHARMACOGNOSTIC, PHYTOCHEMICAL AND PHYSICOCHEMICAL EVALUATION OF LEAVES OF *CAESALPINIA SAPPAN* L. (PATRANGA) WITH AYURVEDIC INSIGHT

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ABSTRACT

Caesalpinia sappan L. (Patranga) is an important medicinal plant widely described in Ayurveda for its therapeutic value. The present study was carried out to evaluate the pharmacognostic, phytochemical, and physicochemical characteristics of Patranga leaves as part of an effort toward their standardization and quality assessment. Macroscopic and microscopic examinations of the leaves revealed characteristic diagnostic features useful for identification and authentication of the crude drug. Preliminary phytochemical screening of different solvent extracts demonstrated the presence of several bioactive constituents, including flavonoids, tannins, carbohydrates, glycosides, steroids, and proteins. Physicochemical evaluation showed a moisture content of 9.71%, suggesting reduced chances of microbial contamination and better storage stability. The total ash, acid-insoluble ash, and water-soluble ash values were found to be 6.61%, 1.35%, and 7.05%, respectively. Alcohol-soluble and water-soluble extractive values were recorded as 12.70% and 18.25%, indicating the predominance of water-soluble constituents. The pH of the leaf powder was observed to be 4.03. The findings generated in the present study provide preliminary reference standards for the identification, authentication, quality control, and

standardization of Patranga leaves. The study also highlights the potential use of leaves as a sustainable alternative to heartwood in herbal formulations and further pharmacological investigations.

KEYWORDS: Patranga, Caesalpinia sappan L., Pharmacognosy, Phytochemistry, Physicochemical Evaluation, Standardization.

INTRODUCTION

Medicinal plants play an important role in traditional systems of medicine, particularly in Ayurveda, where many drugs are used on the basis of long clinical experience. Scientific standardization of these drugs is necessary to support their identity, purity and quality. Pharmacognostic, phytochemical and physicochemical evaluation are commonly used for this purpose and help generate reference parameters for crude drugs and formulations. Caesalpinia sappan, known as Patranga in Ayurveda, is a medicinal plant traditionally used in conditions associated with wound healing, skin disorders, blood purification and gynecological complaints.[1] Patranga possesses Madhura and Tikta Rasa and exhibits Vranaropana (wound-healing) properties, which is used to treat ulcers. It is described as Rakta-Pitta-Kapha Shamaka in Ayurvedic literature.[2] Classical Ayurvedic texts describe its therapeutic properties, while modern studies have reported the presence of constituents such as flavonoids, tannins, phenolic compounds and related bioactive principles that may contribute to its medicinal value. Among methods used for quality evaluation of herbal drugs, pharmacognostic examination provides diagnostic characters for authentication, whereas physicochemical parameters such as ash values, extractive values, moisture content and pH help assess purity, quality and storage stability. Preliminary phytochemical screening also offers supportive information regarding major classes of chemical constituents present in the drug.

Although the medicinal importance of Caesalpinia sappan has been documented, available reports have largely focused on the plant in general or on heartwood, while standardized data relating specifically to the leaves remain limited. In addition, leaf-based evaluation may be relevant from the perspective of sustainable utilization, as leaves can offer a renewable plant material compared with destructive harvesting of heartwood. Establishing reference standards for the leaf drug therefore has practical importance.

The present study was undertaken to evaluate the pharmacognostic characters and determine selected phytochemical and physicochemical parameters of Patranga leaves in order to generate preliminary standards useful for identification, quality control and standardization.

CLASSICAL REFERENCE

Dhanwantari nighantu [1]

Kuchandanam patangam cha raktakastham surangakam

Patrangam pattaragam cha pattaranjanameva cha

Swadu pakarase sheetam shlesmalam natipittalam

Kuchandanam tu tiktam sthat sugandhi vranaropanam (Dha.Ni)

Kuchandana is also known by the names Patanga, Raktakashtha, Surangaka, Patranga, Pattaraga, and Pattaranjana. It possesses a sweet taste after digestion (*Madhura Vipaka*) and has a cooling potency (*Sheeta Veerya*). It tends to increase *Kapha* slightly and does not aggravate *Pitta* excessively. Kuchandana (Patranga) is described as bitter in taste (*Tikta Rasa*), aromatic (*Sugandhi*), and promotes wound healing.

Rajanighantu [2]

*Vatapittajvaraghnam cha visphotonmadabhutahut (Ra Ni***)**

It alleviates fever caused by *Vata* and *Pitta dosha* (*Vata-Pittaja Jwara*) and is beneficial in conditions such as eruptions/blisters (*Visphota*), insanity or mental disturbances (*Unmada*), and disorders traditionally attributed to evil influences or spirit-related afflictions (*Bhuta*)

Bhavaprakasha Nighantu [6]

Patangam madhuram sheetam pittashleshmavranastranut

Harichandanavad vaidyam visheshad dahanashanam (Bha Pa)

Patanga is sweet in taste (*Madhura*) and has a cooling property (*Sheeta*). It helps alleviate disorders of *Pitta* and *Kapha*, promotes healing of wounds (*Vrana*), and controls bleeding disorders (*Asra-dosha*). Similar to Harichandana, it is regarded as therapeutically valuable and is especially effective in relieving burning sensations (*Daha Nashana*).

PHARMACOGNOSTICAL PROFILE

Botanical Name: *Caesalpinia sappan* L.

Family: Fabaceae

Subfamily – Caesalpiniaceae

Table No. 1: Classical categorization.[4, 5, 1, 6, 9, 8]

Samhita	**varga**
Charaka samhita	Shukadhanyadi varga
Sushruta samhita	Kuchandan salsaradi gana
Nighatu	**Varga**
Dhanvantari nighantu	Chnadanadi varga
Bhavprakasha nighantu	Karpuradi varga
Kaiyadeva nighantu	Aushadhi varga
Priya nighantu	Sharadi varga

Table No. 2: Vernacular Names by Region/Language.

English	Sappan Wood
Hindi	Patrang, Bakam
Sanskrit	Patranga, Pattanga
Assamese	Baggam, Bakam
Bengali	Bokom, bakam kastha
Gujrati	Patang
Kannada	Pathanga, chappanga, chakke sappanga
Marathi	Patang
Tamil	Patungam, Pathimugam
Telugu	Bukkapuchettu, vakamu
Malayalam	sappannam, sampannam

Table No. 3: Taxonomic classification for Patranga.[3]

Kingdom	Plantae
Division	Magnoliophyta (Flowering plants)
Class	Magnoliopsida (Dicotyledons)
Order	Fabales
Family	Fabaceae (Legume family)
Genus	Caesalpinia L
Species	Caesalpinia sappan L

Table No. 4: Ayurvedic Properties.[6]

Rasa	*Kashaya, Tikta, Madhura*
Guna	*Laghu, Ruksha*
Veerya	*Sheeta*
Vipaka	*Katu*
Dosha Karma	*Kapha-Pitta Shamak*

BOTANICAL DESCRIPTION.[10]

Caesalpinia sappan is a small, thorny tree that usually attains a height of about 6–9 m with a stem diameter of 15–25 cm. The plant possesses a few prickly branches that often intertwine, forming a dense protective barrier. The leaves are large, bipinnately compound, and consist of 8–12 pairs of oblong leaflets with small prickles.Under favorable conditions, the plant may

grow up to 3–5 m within a year. The flowers are yellow in color and arranged in terminal panicles and racemes. The stamens are waxy white, with filaments that are densely hairy at the base. The fruit is a thick, flattened, woody dehiscent pod with an oblique shape and a prominent beak. The pods are smooth, polished brown in appearance, measuring about 7–10 cm in length and 3–4 cm in width, and usually contain 2–3 seeds, occasionally up to 5. The seeds are brown, flattened, and ellipsoid in shape, measuring approximately 18–20 mm × 10–12 mm.

MACROSCOPIC EVALUATION OF LEAVES (PATRANGA / CAESALPINIA SAPPAN)

The leaves of Caesalpinia sappan are bipinnately compound, measuring approximately 20–45 cm in length and 10–20 cm in breadth. They bear 8–16 pairs of pinnae, each extending up to 20 cm long. Every pinna contains 10–20 pairs of oblong, subsessile leaflets. The individual leaflets are about 10–20 mm long and 6–10 mm broad, having an oblique base with a rounded or slightly notched apex. The dried leaves appear grayish in color, possess a characteristic odor, and exhibit a slightly sour taste.

Fig. 1: Caesalpinea sappan. **Fig. 2: Caesalpinea sappan Linn. Pinnae.**

MICROSCOPIC

Transverse Section of Leaf

Epidermal cells - The outermost compact layer represents the epidermis, which protects the leaf tissue.

Mesophyll tissue - The surrounding parenchymatous region consists of mesophyll cells. These cells appear loosely arranged in some areas, indicating spongy parenchyma.

Vascular bundle -The prominent elongated crossing structure in the center is the vascular bundle (vein).It contains:

Xylem – thick-walled lignified elements responsible for water conduction. Phloem – softer conducting tissue for food transport. Lignified fibers / sclerenchyma The thick bright linear strands associated with the vascular region indicate lignified supporting fibers.

Calcium oxalate crystals / crystal idioblasts - Some rounded refractive bodies may represent crystal-containing cells commonly found in medicinal leaves.

Oil globules / secretory contents - Bright circular structures could indicate oil droplets or secretory contents within parenchymatous cells.

Parenchyma cells - Thin-walled polygonal cells surrounding vascular tissue are parenchymatous cells storing food and metabolites.

stomatal region - Some darker oval structures may correspond to stomatal complexes seen in sectional view.

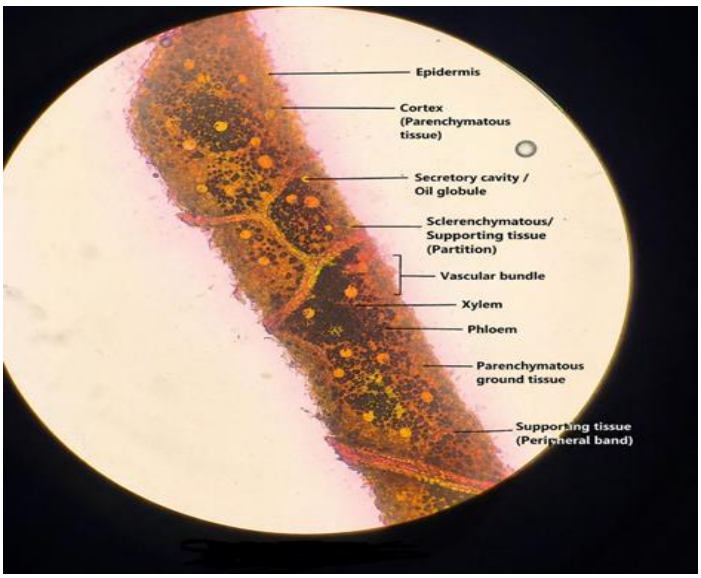

Fig. 3: Transverse Section (T.S.) of Caesalpinia sappan L. Leaf/Petiole Showing Epidermis, Cortex, Secretory Cavities, Supporting Tissue and Vascular Bundle with Xylem and Phloem.

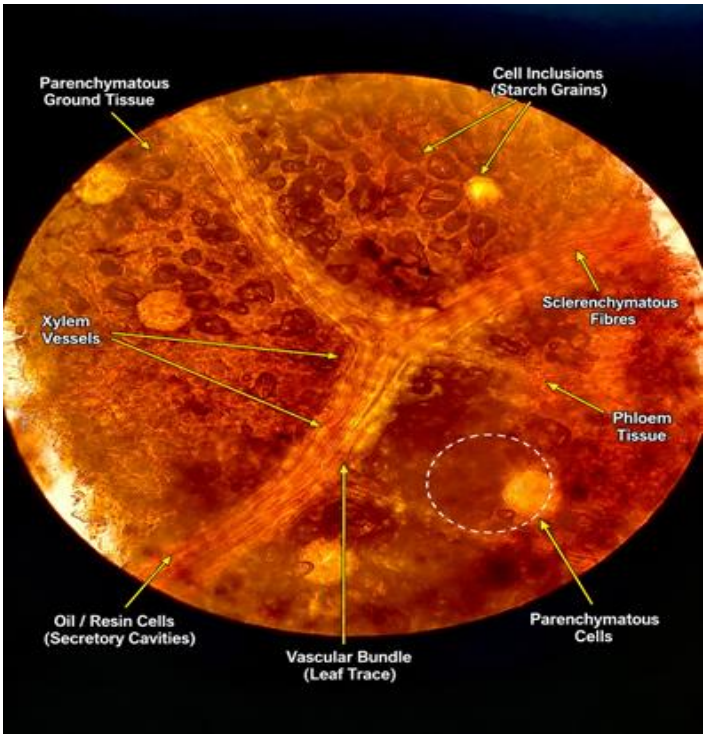

Fig. 4: Transverse Section (T.S.) of Patranga (Caesalpinia sappan L.) Leaf Showing Vascular Bundle, Xylem Vessels, Phloem Tissue, Parenchymatous Ground Tissue, Secretory Cavities and Cell Inclusions under Microscope

POWDER MICROSCOPY

Powder microscopy of Caesalpinia sappan leaf showed characteristic fragmented tissues useful for crude drug identification. Greenish parenchymatous fragments representing mesophyll tissue were observed. Compact palisade and loosely arranged spongy parenchyma fragments were present. Epidermal fragments and possible vascular elements or fibres were noted. Trichomes were absent, supporting the glabrous nature of the leaf. Stomatal structures and calcium oxalate crystals were not distinctly resolved in the present field.

THERAPUTIC APPLICATION[7]

1) Gynacological disorder

Patranga is frequently used to treat issues related to female reproduction. It is very helpful for situations like Rakta Pradara (menorrhagia) and metrorrhagia since it functions as an Artavasangrahaniya (regulator of menstrual flow). Leucorrhea (Shveta Pradara) and other vaginal problems are frequently treated with decoction (Kwatha), Arishta, and Asava formulations like Patrangasava.

2) Skin diseases and wound healing

Patranga is traditionally used both internally and externally in various skin ailments and wound management. Internally, the decoction of Patranga is administered in skin diseases. Externally, a paste prepared from the drug is applied over ulcers, wounds, bleeding lesions, and cut injuries owing to its Vranaropana (wound-healing) property. Patrangadi Lepa is especially recommended in facial dermatological disorders. It is also indicated in conditions such as Kshudra Roga and Kushtha (leprosy).

MATERIALS AND METHODS

PLANT COLLECTION

Healthy, mature leaves of Caesalpinia sappan were collected from the surroundings of Shri Ayurveda Mahavidyalaya, Nagpur, where the plant was found growing abundantly. The collected plant material was carefully washed with clean water to remove adhering impurities. The samples were shade-dried at room temperature for four weeks. After complete drying, the material was powdered using a mixer grinder to obtain a fine powder. Approximately 500 g of the powdered sample was then used for phytochemical and physicochemical analysis.

PREPARATION OF PLANT SOLVENT

For extract preparation, 5 g of powdered plant material was taken in separate conical flasks, and 100 ml of different solvents, namely aqueous, ethanol, methanol, hydro-alcoholic, chloroform, and ether, was added to each flask. The mixtures were stirred for six hours to ensure proper extraction of bioactive constituents and then allowed to stand for 18 hours to facilitate further extraction. After this, the mixtures were filtered through filter paper to separate the plant residue from the liquid extracts. The obtained extracts were then used for phytochemical screening to identify the presence of various bioactive compounds and for evaluation of the physicochemical characteristics of the plant material.

PHYTOCHEMICAL ANALYSIS[11]

Qualitative phytochemical analysis was carried out using six solvents—aqueous, ethanol, methanol, hydro alcoholic, chloroform, and ether—to identify various bioactive constituents present in the sample. Standard phytochemical screening methods were used to detect carbohydrates, flavonoids, tannins, amino acids, starch, glycosides, steroids, triterpenoids, proteins, alkaloids, and saponins. Different solvents were selected to ensure extraction of a broad range of compounds, as water extracts hydrophilic constituents, alcohols dissolve both

hydrophilic and lipophilic compounds, while non-polar solvents such as chloroform and ether help extract lipids, sterols, and volatile constituents. The presence of these phytochemicals was confirmed through characteristic reactions such as color changes, precipitate formation, or foam production The phytochemical analysis of the sample was conducted using several standard tests to detect various bioactive compounds, and the results are summarized in Table.

1. Carbohydrates (Molisch's test): A purple or violet ring appeared at the junction of the test solution after adding alcoholic α-naphthol and concentrated sulfuric acid, indicating the presence of carbohydrates.

2. Flavonoids:

Shinoda test: A pink, scarlet, crimson red, or occasionally green to blue color appeared after adding magnesium turnings and concentrated HCl.

Alkaline reagent test: An intense yellow color formed when sodium hydroxide was added, which turned colorless after adding dilute HCl.

Zinc hydrochloride test: A red color formed after adding zinc dust and concentrated HCl.

3. Tannins

Ferric chloride test: A green color appeared after adding ferric chloride solution, indicating the presence of condensed tannins.

Lead acetate test: A white precipitate formed after adding lead acetate solution, confirming the presence of tannins.

4. Amino Acids (Ninhydrine test): A violet color appeared after adding ninhydrine and boiling the test solution, indicating the presence of amino acids.

5. Glycosides (Fehling's solution test): Hydrolyzed extract was treated with equal volumes of Fehling's solution A and B and heated in a water bath; formation of a brick-red precipitate indicated the presence of glycosides.

6. Steroids and Triterpenoids: Libermann-Burchard test: The upper layer turned green when acetic anhydride and sulfuric acid were added, indicating steroids. A deep red color indicated triterpenoids.

7. **Proteins (Xanthoproteic test):** An orange color appeared after adding nitric acid and boiling, confirming the presence of proteins.

8. Alkaloids

Mayer's test: A cream-colored precipitate formed with Mayer's reagent.

10. **Saponins (Froth formation test):** Persistent froth formed when the test solution was shaken with water, indicating the presence of saponins.

PHYSICOCHEMICAL ANALYSIS.[12]

The physicochemical analysis helps in assessing the quality of the crude drugs. Biochemical variation, adulteration, substitution, effects of storage occurring in the drug can be tested. The foreign matter, moisture content / loss on drying, total ash, acid insoluble ash, water soluble ash, water soluble extractive and pH of the powdered sample were determined by using standard procedure mentioned in the context of the WHO guidelines for the assessment of herbal medicines. These guidelines provide a framework for ensuring the quality, safety and efficacy of herbal medicines

RESULTS AND DISCUSSION

Table No. 5: phytochemical analysis.

Phytochemical	Test performed	Solvents					
		Aqueous	Ethanol	Methanol	Hydroalcoholic.	Chloroform	Ether
Carbohydrate	Molisch's test	+	_	_	+	+	+
Flavonoid	Shinoda test	_	_	+	_	+	_
	Alkaline reagent Test	+	+	+	+	+	+
	Zinc dust test	_	+	+	+	_	_
Tannin	Ferric chloride test	_	+	+	_	_	_
	Lead acetate test	+	+	+	+	+	_
Amino acid	Ninhydrine test	_	_	_	_	_	_
Glycoside	Baljet's test	_	_	+	+	_	_
Steroids	Libermann's Burchard test	–	–	–	–	–	–
Triterpenoid	Libermann's Burchard test	–	–	–	–	–	+
Protein	Xanthoproteic test	+	+	+	+	+	+
Alkaloid	Mayer's test	_	_	_	_	_	_
Saponin	Froth test	_	_	_	_	_	_

Table No. 5: physicochemical evaluation showed.

Sr.No	Parameter	Observed value
1	Moisture content	9.71%
2	Total ash	6.61%
3	Acid-insoluble ash	1.35%
4	Water-soluble ash	7.05%
5	Alcohol extractive	12.70%
6	Water extractive	18.25%
7	PH	4.03

These values indicate acceptable quality, purity, and stability of the crude drug. The present study provides a comprehensive pharmacognostical, phytochemical, and physicochemical evaluation of Caesalpinia sappan L. leaves (Patranga), contributing to the establishment of standardization parameters for this medicinal plant. Pharmacognostic analysis revealed distinct macroscopic and microscopic characteristics such as bipinnate compound leaves, dorsiventral leaf structure, presence of paracytic stomata on the lower epidermis, and absence of trichomes. These diagnostic features are crucial for correct identification and help in distinguishing the genuine drug from possible adulterants. Powder microscopy further supported identification by showing characteristic mesophyll fragments, palisade cells, and epidermal tissues, which are commonly used markers in crude drug authentication. The absence of trichomes and indistinct calcium oxalate crystals may serve as additional identifying features.

Phytochemical screening demonstrated the presence of important bioactive constituents including flavonoids, tannins, carbohydrates, glycosides, steroids, and proteins. These compounds are well known for their pharmacological activities such as antioxidant, anti-inflammatory, antimicrobial, and wound healing properties. The presence of flavonoids and tannins particularly supports the traditional use of Patranga in skin disorders, wound healing, and blood purification. Variation in phytochemical presence across different solvents indicates the importance of solvent polarity in extracting diverse groups of phytoconstituents.
Physicochemical parameters obtained in the study fall within acceptable limits, indicating good quality and purity of the drug. The moisture content (9.71%) suggests low susceptibility to microbial growth and better shelf stability. Ash values (total ash, acid-insoluble ash, and water-soluble ash) indicate minimal inorganic contamination and provide insight into the purity of the sample. Higher water-soluble extractive value compared to alcohol-soluble extractive suggests the predominance of hydrophilic constituents. The slightly acidic pH

(4.03) may be beneficial for formulation stability and compatibility in therapeutic preparations.

Overall, the findings align with classical Ayurvedic descriptions and previously reported phytochemical studies, while also highlighting the significance of leaf-based evaluation. Since most earlier studies focused on heartwood, this study supports the potential of leaves as a sustainable and non-destructive alternative source of medicinal raw material.

CONCLUSION

The present study successfully establishes preliminary pharmacognostical, phytochemical, and physicochemical standards for Caesalpinia sappan L. leaves (Patranga). The identification of key diagnostic features and the presence of significant bioactive constituents validate its traditional therapeutic uses described in Ayurveda. The physicochemical parameters generated in this study can serve as reliable reference standards for quality control, authentication, and standardization of Patranga leaf-based formulations. Additionally, the study highlights the potential of using leaves as a sustainable alternative to heartwood, promoting conservation of the plant. Further studies involving quantitative phytochemical analysis, pharmacological validation, and clinical evaluation are recommended to explore its full therapeutic potential and support its wider application in herbal medicine.

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