RESEARCH PAPER

A CRITICAL REVIEW OF THE AYURVEDIC AND PHARMACOGNOSTICAL PROFILE WITH ANALYTICAL STANDARDISATION OF THE SHIGRU (*MORINGA OLEIFERA* LAM.) FRUIT (POD)

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Abstract

Shigru (*Moringa oleifera* Lam., family *Moringaceae*) is one of the most extensively described *Dravyaguna* plants of classical *Ayurveda*, referred to across the *Brihatrayee* and later *Nighantu* literature by numerous *Sanskrit* synonyms such as *Shobhanjana, Tikshnagandha* and *Mochaka*, and simultaneously recognised the world over as a nutraceutical "miracle tree" for its exceptionally rich content of vitamins, minerals and bioactive phytoconstituents. Despite this extensive traditional and pharmacological literature, pharmacognostical standardisation of the raw drug — particularly the *phala* (pod) — remains comparatively under-documented. This article synthesises the classical (*Ayurvedic*), botanical and phytochemical review of *Shigru* together with an original pharmacognostical and preliminary analytical study of *Shigru phala*. Macroscopic, microscopic, physicochemical (foreign matter, loss on drying, total ash, acid-insoluble ash, water-soluble ash and extractive values), qualitative phytochemical screening, elemental testing and thin-layer chromatographic (TLC) parameters were determined by standard pharmacopoeial methods. The pod was found to be *Katu–Tikta* in *rasa*, *Ushna virya* and *Kapha–Vatahara* in action, correlating with its reported *Deepana, Pachana, Shothahara* and *Krimighna* properties. Phytochemical screening confirmed the presence of alkaloids, flavonoids, saponins, sterols and tannins, and TLC profiling supported the presence of antioxidant phenolic/flavonoid constituents. The compiled physicochemical constants and chromatographic fingerprint are proposed as reference standards for identification, quality control and authentication of *Shigru phala* in future pharmacopoeial and research work.

Keywords: *Ayurveda, Shigru, Moringa oleifera, Dravyaguna*, *Rasapanchaka,* pharmacognosy, physicochemical evaluation, phytochemical screening, thin-layer chromatography.

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1. Introduction

Ayurveda is founded on the principles of *Tridosha* and *Panchamahabhuta*, the three *Doshas* being formed through different combinations and proportions of the five basic elements. Since the human body (*Sharira*) is itself *Panchabhautika* in composition, the drugs used for its treatment are considered *Panchabhautika* in nature as well, and medicine occupies a central place among the four pillars of treatment, *Chikitsa Chatushpada*, placed immediately after the physician in importance.[1] An ideal drug, according to *Acharya Charaka*, should possess four qualities — abundant availability, therapeutic effectiveness, adaptability to varied pharmaceutical forms, and a natural, balanced composition.[1]

The World Health Organization defines a drug as any substance or product administered to alter, investigate or influence physiological or pathological function for the therapeutic benefit of the recipient, and estimates that nearly 80% of the world's population continues to depend on traditional medicine systems for primary healthcare.[2,46] India, with its exceptional botanical and cultural diversity, possesses one of the oldest continuous traditions of medicinal plant use in the world.[3,55,56] Among these plants, *Shigru* (*Moringa oleifera* Lam.) stands out for the sheer breadth of its classical description and contemporary scientific interest. Native to the sub-Himalayan tracts of north-western India and now cultivated throughout the tropics and subtropics, it is a fast-growing, drought-tolerant tree in which "all parts possess therapeutic value", earning it the popular epithet of the "miracle tree" worldwide.

While the pharmacological and nutritional literature on *Moringa oleifera* has expanded

rapidly over the past two decades, systematic pharmacognostical standardisation of the raw drug — particularly of the *phala* (pod), a part explicitly recognised as *Shigru Beeja*/*Phala* in classical texts — has received comparatively little attention. This article therefore (i) consolidates the classical *Ayurvedic* review of *Shigru* drawn from the *Brihatrayee*, *Nighantu* literature and allied *Dravyaguna* texts; (ii) reviews its botanical description, distribution, cultivation and phytochemistry; and (iii) reports an original pharmacognostical and preliminary analytical study of *Shigru phala*, intended to serve as a reference standard for identification and quality control.

2. Aim, Objectives and Materials and Methods

2.1 Aim

To carry out a comprehensive Ayurvedic and botanical review of *Shigru* (*Moringa oleifera* Lam.) and a detailed pharmacognostical, physicochemical and preliminary phytochemical study of its fruit (pod), in order to establish standards useful for identification and quality control.

2.2 Objectives

- To compile the *Nirukti*, synonyms, classification and *Rasapanchaka* of *Shigru* as described across classical *Samhita* and *Nighantu* literature.
- To review the botanical description, distribution, cultivation and phytochemical profile of *Moringa oleifera* Lam.
- To determine the macroscopic (organoleptic) characters of *Shigru* fruit.
- To study the microscopic (transverse section) and powder-microscopic characters of *Shigru* fruit.
- To determine the physical and physicochemical constants of *Shigru* fruit — foreign matter, moisture content, pH, total ash, acid-insoluble ash, water-soluble ash and extractive values.
- To carry out preliminary qualitative phytochemical screening and elemental testing of *Shigru* fruit extracts.
- To perform a thin-layer chromatographic (TLC) study of *Shigru* fruit extract.

2.3 Materials and Methods

The classical review was compiled through a systematic literature search of the *Brihatrayee* (*Charaka, Sushruta* and *Ashtanga* texts), major *Nighantu* (*Dhanvantari, Kaiyadeva, Bhavaprakasha, Raja, Shodhala, Madanapala* and others), and standard *Dravyaguna* and pharmacognosy textbooks, supplemented by peer-reviewed pharmacological literature on *Moringa oleifera*. For the analytical study, fresh, mature, disease-free pods of *Shigru* were collected, authenticated, and a voucher specimen deposited for future reference. Seeds were removed from the dried pods; the pod wall/pulp was shade-dried, pulverised, passed through a 40-mesh sieve and stored in an air-tight container. Macroscopic, microscopic, physicochemical, phytochemical and chromatographic evaluations were carried out following standard pharmacopoeial protocols of the Ayurvedic Pharmacopoeia of India[4] and the WHO Quality Control Methods for Medicinal Plant Materials[5,47,48].

3. Ayurvedic Review of *Shigru*

3.1 *Nirukti* (Etymology)

शिनोति तीक्ष्णतां विदधाति । — the name *Shigru* derives from a root indicating a very potent, sharp (*Tikshna*) quality, reflecting the pronounced pungency and penetrating action attributed to the drug in classical texts.[7]

3.2 Synonyms

Several important synonyms of *Shigru* recur across the *Vrihatrayee* and the *Nighantu* literature, each capturing a distinct morphological or pharmacological feature of the plant:

Table 1: Selected synonyms of *Shigru* and their significance [6]

Synonym	Significance / occurrence
Dirghaka	Long, tripinnate, compound leaves
Laghupatraka	Small leaflets
Mukhabhanga	Bitter taste distorts facial expression
Shobhanjana / Shigruka	Beautiful flowering plant with sharp (*Tikshna*) odour
Ghanacchada	Densely covered with leaves
Sitahvaya	*Madhura* (sweetish) after-taste
Akshiva, Moolakparni	*Charaka Samhita* only
Bahalpallava, Shukla/Shweta marich	*Sushruta* and *Ashtanga Hridaya*

3.3 Vernacular Names

Table 2: Vernacular names of *Shigru* in major Indian languages

Language	Vernacular name
Sanskrit	*Shigru, Shobhanjana*
Hindi	*Sahjan, Munga*

Language	Vernacular name
English	Drumstick tree, Horse-radish tree
Marathi	*Shevga*
Gujarati	*Saragavo*
Bengali	*Sajina*
Tamil	*Murungai*
Telugu	*Munaga*
Kannada	*Nugge*
Malayalam	*Muringa*

3.4 Taxonomical Position and Classification (*Gana*)

Classically, *Shigru* is grouped under *Shakavarga* (pot-herb group) by *Acharya Charaka* and under *Varunadi, Shyamadi* and *Adhobhagahara Gana* by *Sushruta* and *Vagbhata*, reflecting its use both as a food and as a *Shodhana* (purificatory) drug. Its botanical taxonomic position is summarised in Figure 1.

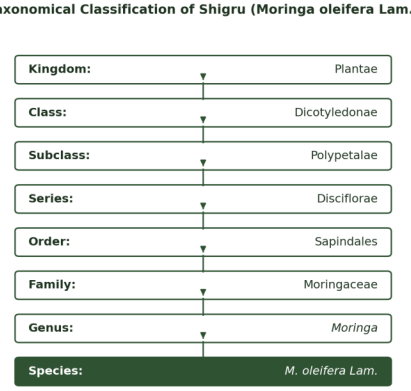

Figure 1: Taxonomical classification of Shigru (Moringa oleifera Lam.)

3.5 Historical Background

Shigru finds mention from the *Vedic* period onward — the *Rigveda* and *Atharvaveda* refer to it in the context of purification and disease-alleviation, and it is described in the *Kaushika Sutras* and several *Puranas*. It receives detailed treatment in all three texts of the *Brihatrayee* (*Charaka, Sushruta* and *Ashtanga Hridaya/Samgraha*) as well as in later compendia such as *Vangasena, Gadanigraha* and *Sharangadhara Samhita*. Over twenty-five *Nighantu* (lexicons), from *Amarakosha* (c. 4th–5th cent. A.D.) through *Priya Nighantu* (20th cent. A.D.), consistently record its synonyms, *Rasapanchaka* and therapeutic indications, attesting to an unbroken two-millennium tradition of use.[49,50,55,56]

3.6 *Rasapanchaka* (Pharmacodynamic Properties)

Rasapanchaka — the classical framework of *Rasa, Guna, Virya, Vipaka* and *Prabhava* — governs the pharmacodynamic and pharmacokinetic explanation of drug action in *Ayurveda*. For *Shigru*, this is consistently recorded across the *Nighantu* as follows:[8]

Table 3: *Rasapanchaka* of *Shigru*

Property	Description
Rasa (taste)	*Katu* (pungent), *Tikta* (bitter)
Guna (qualities)	*Laghu* (light), *Ruksha* (dry), *Tikshna* (sharp/penetrating)
Virya (potency)	*Ushna* (hot)
Vipaka (post-digestive effect)	*Katu* (pungent)
Doshaghnata	*Kapha–Vatahara* (pacifies *Kapha* and *Vata Dosha*)
Karma (actions)	*Deepana, Pachana, Shothahara, Shoolahara, Hridya, Krumighna*

3.7 Effect on *Dosha* and *Rogaghnata* (Therapeutic Indications)

By virtue of its *Laghu, Ruksha, Tikshna Guna*, *Ushna Virya* and *Katu Vipaka*, *Shigru* is uniformly described across the *Nighantu* as *Vata* and *Kapha-shamaka*; a minority of texts (*Kaiyadeva* and *Bhavaprakasha Nighantu*) additionally note a mild *Pittavardhaka* tendency attributable to its *Ushna Virya*.[9] The drug is repeatedly indicated across the classical lexicons for a wide range of conditions, the most consistently cited being summarised in Table 4.[9]

Table 4: Principal *Rogaghnata* (indications) of *Shigru* compiled across major *Nighantu*

Roga (condition)	Modern correlate
Shotha / Shophahara	Inflammation, oedema
Vranahara	Wound healing
Kandu	Pruritus
Kushtha	Skin disorders
Krimi / Krimiroga	Helminthiasis
Gulma, Pliharoga	Abdominal lump, splenic disorders
Arsha	Haemorrhoids
Raktavikara	Blood disorders
Shirovata, Mukhajadya	*Vata* disorders of head and facial region
Vataroga, Vidradhi, Visha	*Vata* disorders, abscess, poisoning

3.8 Varieties and Useful Parts

The *Raja Nighantu* describes four varieties — *Shigru, Neel Shigru, Shwet Shigru* and *Rakta Shigru*[10] — while the *Bhavaprakasha Nighantu* recognises two: *Shigru* (*Moringa oleifera* Lam.) and *Madhu-Shigru* (*Moringa concanensis* Nimmo).[8] The *Useful parts* (*Upayukta Anga*) recognised are *Beeja* (seed), *Patra* (leaf), *Phala* (fruit/pod) and *Twak* (bark).[14]

4. Botanical Review

The generic name *Moringa* derives from the Tamil *murungai*, and the species epithet *oleifera* from the Latin *oleum* (oil) + *ferre* (to bear) — *Moringa oleifera* thus translates literally to "an oil-bearing drumstick tree", a description that anticipates its oil-rich seed, discussed further in Section 5.[50]

4.1 Habitat and Distribution

The white-flowered variety, *Moringa oleifera* Lam. (*Katu Shigru*), is native to the sub-Himalayan tracts and is now distributed widely across India — notably Assam, Gujarat and Uttar Pradesh — as well as tropical Africa, Sri Lanka, tropical America, Malaysia and the Philippines.[13] It is a hardy, drought-tolerant species that adapts readily to poor soils and is commonly encountered along riverbanks, in hedgerows and in household gardens. The comparatively rare red-flowered variety, *Madhu-Shigru* (*Moringa concanensis* Nimmo), occurs in restricted pockets of Bengal, Rajputana, Sindh, the Konkan region, Andhra Pradesh and Coimbatore, distinguished by longer leaves and pinkish-yellow flowers.[11]

4.2 Morphology

Table 5: Morphological characters of *Moringa oleifera* Lam.

Part	Characters
Habit	Fast-growing, small deciduous tree or slender shrub, 9–15 m tall, with an open, umbrella-like canopy
Leaves	Alternate, tripinnate, feathery, 30–90 cm long; 4–7 pairs of pinnae; elliptic lateral leaflets, larger obovate terminal leaflet
Stem / Bark	Trunk often twisted, up to ~30 cm diameter, branching near the base; bark smooth, corky, dark brown with yellowish markings
Root	Stout taproot with papery, cork-like outer layer; wood soft, golden and porous
Flowers	Fragrant, borne in axillary panicles up to 15 cm; 5 pale-green sepals, 5 unequal white petals, 10 stamens (5 fertile + 5 sterile)
Fruit (*Phala*)	Long, pendulous, three-angled, longitudinally ridged capsule, 30–90 cm × ~1.4 cm, dehiscing into 3 valves at maturity, enclosing ~20 seeds
Seeds	Rounded, oil-rich, blackish-brown, ~2 cm, cork-like testa with 3 papery wings; exalbuminous with straight embryo

Figure 2: Fresh Shigru pods, seeds, leaves and flowers (Moringa oleifera Lam.*)*

4.3 Cultivation

Propagation is simplest from seed, which lacks any dormancy period and can be sown directly at ~2 cm depth in nursery rows spaced ~20 cm apart, with seedlings thinned to ~10 cm spacing and transplanted after about a year; direct field sowing often gives quicker establishment. Propagation from stem cuttings (45 cm–1.5 m) is faster still, though there is some debate on the comparative vigour of cutting- versus seed-raised trees.[12]

5. Phytochemistry

Modern re-interpretation of *Rasa, Guna, Virya, Vipaka* and *Prabhava* through concepts such as ionisation, stereochemistry, polarity and isomerism has increasingly linked the classical *Rasapanchaka* framework to the underlying chemistry of a drug, lending pharmacological rationale to traditional descriptions.[15] *Shigru* is one of the most extensively phytochemically characterised *Ayurvedic* drugs: it is a rich source of essential amino acids, vitamins, minerals, fatty acids, carotenoids and bioactive compounds including flavonoids, vanillin, 4-hydroxymellin, moringine, moringinine, benzyl isothiocyanate, pterygospermine and spirochin, of which pterygospermine has documented antibiotic activity.[16,20,21,22,23,29]

Distribution of these constituents is markedly part-specific: the roots yield the antibiotic pterygospermine, the bark the alkaloid moringine (together with a gum resin), and the

seeds up to ~36.6% oil, while the leaves are especially rich in carotene and ascorbic acid.[16] Pharmacologically, aqueous stem-bark extract has been reported to raise cardiac contractility (and blood pressure) at low doses but to lower it at higher doses; root-bark moringinine relaxes bronchial smooth muscle, slows gut motility and acts as a sympathomimetic cardiac stimulant; anthonine shows antibacterial activity against *Vibrio cholerae*; spirochin exhibits antibacterial, analgesic and antipyretic action with dose-dependent effects on heart rate; and benzyl isothiocyanate, abundant in roots and seeds, shows potent antimicrobial and antifungal activity.[16]

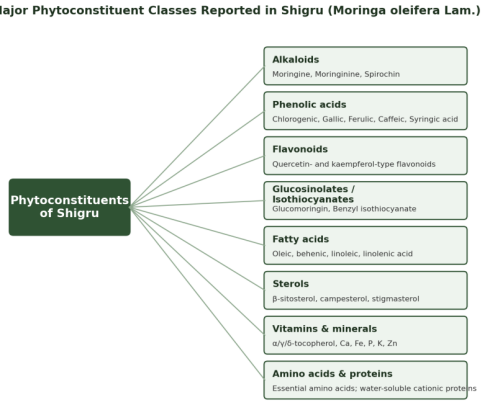

Figure 3: Major phytoconstituent classes reported in Shigru (Moringa oleifera Lam.)

Table 6: Phytochemical profile of *Moringa oleifera* raw materials (seed)

Group	Representative compounds	Source
Phenolic acids	Chlorogenic acid, ellagic acid, ferulic acid, gallic acid, caffeic acid, syringic acid	Seeds
Catechins	Catechin	Seeds
Glucosinolates	4-O-(α-L-rhamnopyranosyloxy)-benzylglucosinolate (glucomoringin)	Seeds
Isothiocyanates	4-(α-L-rhamnosyloxy) isothiocyanate	Seeds
Vitamins	α-, γ- and δ-tocopherol	Seeds
Minerals	Phosphorus, magnesium, potassium, calcium, zinc, iron	Seeds
Fatty acids	Arachidic, behenic, eicosenoic, erucic, α-linolenic, oleic, palmitic, palmitoleic, stearic acid	Seeds
Sterols	β-sitosterol, campesterol, stigmasterol, clerosterol and related avenasterols	Seeds
Amino acids	Alanine, arginine, cysteine, phenylalanine, glycine, histidine, isoleucine, leucine, lysine, methionine and others	Seeds

5.1 Seed and Pod Composition

Each *Shigru* seed weighs ~0.3 g with a kernel-to-hull ratio of about 75:25, and a single tree may bear 15,000–25,000 seeds annually.[18,59,60] On average a pod weighs ~7.95 g and yields ~16 seeds (average 100-seed weight ~30.2 g). Seed macromolecular composition is dominated by oil (30–40%, the pale, stable, non-drying "Ben oil" used in cosmetics, lubricants and salad dressings), protein (~31%, rising to ~52% crude protein in the de-oiled press cake, which is rich in sulphur-containing amino acids and functions as a natural water-purifying cationic polyelectrolyte) and carbohydrate (9–16%, of which crude fibre accounts for 4.7–9%).[17,18] Pod (*Shobhanjana*) nutritional analysis reports ~86.9% moisture, 2.5% protein, 4.8% fat and 5.3 mg iron per 100 g, together with ~120 mg/100 g ascorbic acid and appreciable nicotinic acid and carotene.[58,59]

6. Pharmacognostical (Analytical) Study of *Shigru Phala*

Pharmacognosy — from the Greek *pharmakon* (drug) and *gnosis* (knowledge) — is the branch of pharmaceutical science dealing with the identification, morphology, cultivation, chemical composition and use of crude drugs. *Acharya Charaka* makes an analogous point: a drug unknown in its name, form and properties, or one known but wrongly used, can cause harm rather than benefit.[19,26,27] Macroscopic, microscopic, powder and physicochemical evaluation therefore forms an essential first step before any pharmacological or clinical study can be considered scientifically valid, and was accordingly carried out here on *Shigru phala* following the flow shown in Figure 4.[51,52,53,54]

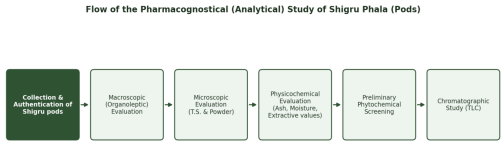

Figure 4: Flow of the pharmacognostical (analytical) study of Shigru phala

6.1 Plant Material

Mature pods of *Shigru* (*Moringa oleifera* Lam.) were collected and botanically authenticated. Seeds were removed from the dried pods; the pod wall/pulp was shade-dried, pulverised using a mechanical grinder, passed through a 40-mesh sieve and stored in an air-tight container for subsequent analysis. Reagents and apparatus used included hydrochloric acid, sodium hydroxide, glacial acetic acid, Mayer's, Dragendorff's and Wagner's reagents, ferric chloride, Molisch's reagent, ninhydrin, Fehling's solutions A and B, Benedict's reagent, lead acetate, Millon's reagent, silica-gel 60 F_{254} TLC plates, a digital balance, muffle furnace, hot-air oven, water bath and Whatman filter paper No. 1.

6.2 Macroscopic (Organoleptic) Evaluation

Macroscopic evaluation of the organoleptic and visible morphological characters is the first and most rapid method of preliminary crude-drug identification, and is carried out before microscopic and chemical evaluation.

Table 7: Organoleptic evaluation of Shigru fruit

Character	Observation
Fruit type	Long, pendulous, three-angled capsule (pod), dehiscent at maturity
Shape	Slender, cylindrical to triangular with longitudinal ridges
Size	20–60 cm long, 1–2 cm broad (varies with variety)
Colour	Green when immature; light to dark brown when mature and dried
Odour	Slightly characteristic; almost odourless when dried
Taste	Slightly bitter, mildly pungent, characteristic
Surface	Smooth with prominent longitudinal ridges; glabrous
Texture	Tender, succulent when immature; hard, woody, fibrous when mature
Fracture	Fibrous (immature); hard and splintery (mature, dried)
Appearance	Long, pendulous, ridged pods containing numerous seeds separated by pith

6.3 Microscopic Evaluation

Microscopic examination reveals the anatomical and cellular architecture of the fruit and is particularly useful for identification, authentication and detection of adulteration in powdered drug. Fresh material was fixed in FAA (formalin–aceto–alcohol: distilled water + 50% alcohol + 2 ml formalin + 2 ml glacial acetic acid per 100 ml) for 24–48 hours; free-hand transverse sections were cut, examined unstained and then stained with phloroglucinol and concentrated hydrochloric acid to demonstrate lignified elements, and observed at 10×, 40× and 100× magnification.

Transverse-section characters of *Shigru* fruit:

- **Epicarp:** A single layer of compact, rectangular epidermal cells covered by a thin cuticle
- **Mesocarp:** Several layers of chlorophyll-bearing parenchyma, scattered vascular bundles, abundant fibrous tissue
- **Endocarp:** Compact sclerenchymatous cells forming a hard inner layer enclosing the seeds
- **Vascular bundles:** Numerous collateral bundles in the mesocarp, xylem inward and phloem outward
- **Sclerenchyma:** Well-developed lignified fibres and sclereids distributed through the mesocarp
- **Other features:** Spiral and pitted vessels; occasional calcium oxalate crystals

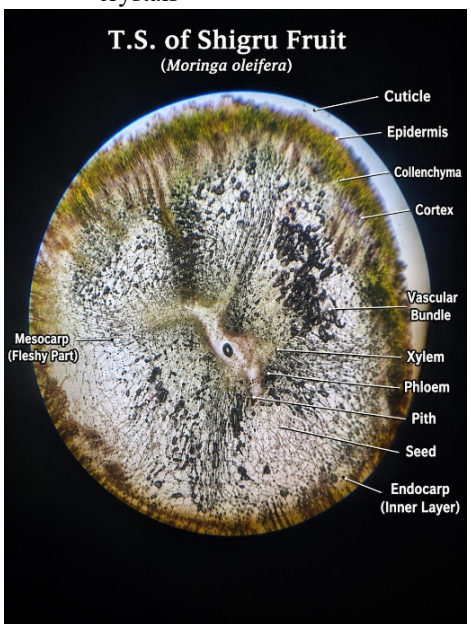

Figure 5: Transverse section (T.S.) of Shigru fruit showing epicarp, mesocarp, vascular bundles and seed

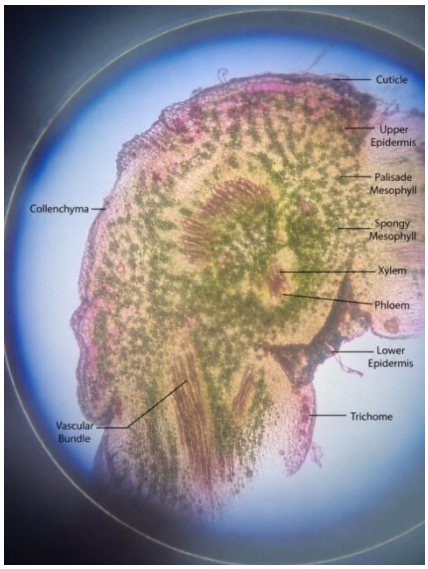

Figure 6: Transverse section (T.S.) of Shigru leaf for comparison, showing cuticle, mesophyll and vascular bundle

6.4 Powder Microscopy

Table 8: Organoleptic evaluation of *Shigru* fruit powder

Parameter	Finding
Colour	Green to dark green
Odour	Faint, characteristic
Taste	Slightly bitter, mildly pungent
Texture	Fine, soft powder
Solubility in water	Light to dark green colouration imparted
Solubility in methanol	Dark green colouration imparted

Powder microscopy revealed diagnostic elements including stone cells (sclereids), pitted vessel elements, fibres, calcium oxalate crystals, parenchyma cells and brown pigmented fragments (Figure 7).

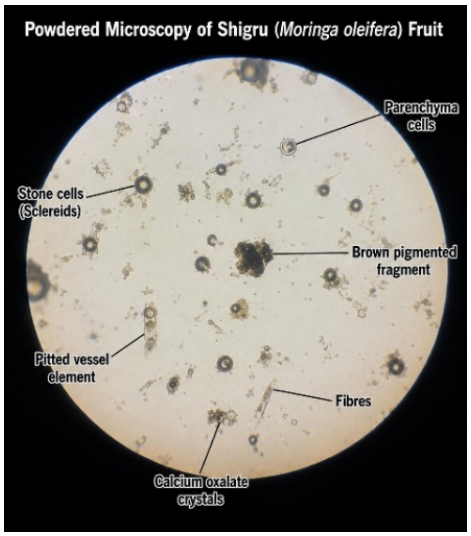

Figure 7: Powder microscopy of Shigru (Moringa oleifera) fruit showing stone cells, pitted vessels, fibres and calcium oxalate crystals

6.5 Physical and Physicochemical Evaluation

Foreign matter was determined by spreading a 5 g sample on a white sheet and inspecting it under 6× magnification; the separated foreign matter was weighed and its percentage calculated as $(X/W_1) \times 100$. Loss on drying (moisture content) was determined by drying a 5 g sample at 105°C to constant weight, expressed as $[(W3-W2)/X] \times 100$. Total ash, acid-insoluble ash and water-soluble ash were determined by igniting 6 g of powdered drug in a muffle furnace at 450°C to a carbon-free ash, and alcohol- and water-soluble extractive values by exhaustive maceration of 5 g powder in the respective solvent for 24 hours followed by evaporation to dryness.

Table 9: Physical and physicochemical constants of *Shigru* fruit

Parameter	Value
Foreign matter	1.59% w/w
Loss on drying (moisture content)	4.0%
pH (1% w/v aqueous solution)	6.2
Acid-insoluble ash	6.66%
Water-soluble ash	0.87%

Figure 8: Determination of ash values of Shigru fruit powder (muffle furnace ignition)

Extractive values

Table 10: Solvent-extractive values of *Shigru* pod powder (5 g sample, 24-hour maceration)

Solvent	Percentage yield (w/w)
Distilled water	3.98%
Methanol	42.92%
Glacial acetic acid	17.2%
Chloroform	17.96%

Figure 9: Solvent extractive values — aqueous, methanolic, glacial acetic acid and chloroform extracts of Shigru pod

The markedly higher methanolic yield (42.92%) relative to the aqueous, acetic-acid and chloroform extracts indicates that the pod is comparatively rich in polar-to-moderately-polar constituents such as phenolics, flavonoids and glycosides, consistent with the phytochemical screening results below.

6.6 Preliminary Phytochemical Screening

Aqueous, ethanolic, methanolic and chloroform extracts of *Shigru* pod powder were screened qualitatively for major phytoconstituent classes using standard colour/precipitation reactions — Mayer's, Dragendorff's and Wagner's tests for alkaloids; the sodium hydroxide test for flavonoids; froth and lead-acetate tests for saponins; the Salkowski reaction for sterols/steroids; the ferric chloride test for tannins; Molisch's, Benedict's and Fehling's tests for carbohydrates; Biuret, Millon's and ninhydrin tests for proteins/amino acids; and Borntrager's test for glycosides.

A

Table Qualitative phytochemical screening of *Shigru* (*Moringa oleifera*) pod extracts

Constituent	Aqueous	Ethanolic	Methanolic	Chloroform
Alkaloids	+	+	+	+
Flavonoids	+	+	+	−
Saponins	−	+	−	+
Sterols	+	+	+	+
Tannins	+	−	+	−

(+) present; (−) absent.

Elemental (inorganic) testing

Ash-derived test solutions were examined for major inorganic elements: calcium (white precipitate with conc. H_2SO_4), iron (red colour with potassium thiocyanate reagent), phosphorus (yellow colour with ammonium molybdate) and potassium (crystalline potassium perchlorate with 15% $HClO_4$).

Table 12: Elemental screening of *Shigru* fruit ash

Inorganic element	Result
Calcium	+
Iron	+
Phosphorus	+
Potassium	+

6.7 Thin-Layer Chromatography (TLC)

TLC was performed on silica gel 60 F_{254} pre-coated plates (10 × 20 cm, 0.25 mm layer), activated at 105°C for 1.5 hours. The chloroform extract of the pod was applied as spots, and the plate developed using toluene : methanol (9:1 v/v) as the mobile phase and visualised under UV light (365 nm).

Table 13: Rf values obtained on TLC of *Moringa oleifera* pod (chloroform extract; toluene:methanol 9:1; UV 365 nm)

Spot no.	Rf value
1	0.14

Spot no.	Rf value
2	0.36
3	0.42
4	0.48
5	0.51
6	0.58
7	0.75

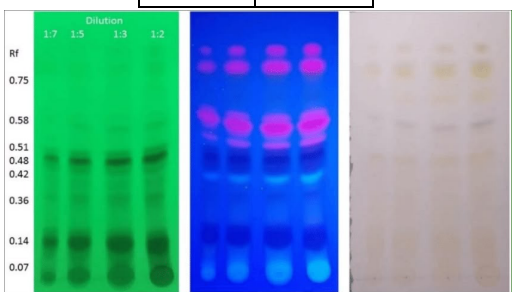

Figure 10: TLC profile of Moringa oleifera pod extract under visible light, long-UV (365 nm) and post-derivatisation

Sequential extraction with solvents of increasing polarity (petroleum ether, benzene, chloroform, ethyl acetate, ethanol, water) followed by TLC profiling has similarly demonstrated the presence of phenolics, triterpenoids, cardiac glycosides, steroids, alkaloids and saponins in *Shigru* pod extracts, supporting the conclusion that the pod is a rich natural source of antioxidant principles.[44,45,48]

7. Pharmacological and Therapeutic Applications

The classical *Rogaghnata* of *Shigru* (Table 4) finds broad support in contemporary pharmacological literature. Its *Shothahara* (anti-inflammatory) and *Vranahara* (wound-healing) actions correlate with documented antibacterial and anti-inflammatory activity of the seed, effective against conditions ranging from arthritis and rheumatism to gout; its *Krimighna* property is consistent with the antimicrobial and antifungal activity of benzyl isothiocyanate; and its *Deepana–Pachana* action aligns with traditional and contemporary use of the pod and leaf as a digestive vegetable.[20,21,22,23,40,41]

7.1 Additional and Non-Medicinal Applications

- **Culinary use:** Leaves, flowers, immature pods and mature seeds are widely consumed across India, Pakistan and the Philippines; tender leaves taste watercress-like, immature pods resemble asparagus when cooked, and mature seeds have a peanut-like flavour.[60]
- **Animal feed and growth promotion:** Moringa leaf meal, included at up to 50% of feed, improves weight gain, blood parameters and productivity in livestock, poultry and fish.[37,38,39,61]
- **Water purification:** Powdered Moringa seeds act as a natural coagulant/antiseptic for drinking-water purification and have shown potential for removing cadmium from contaminated water.[30,31,32,33,34,35,36]

8. Discussion

The convergence of classical and contemporary description of *Shigru* is notable. Its *Ushna Virya*, *Tikshna Guna* and *Katu–Tikta Rasa* find direct chemical correlates in its high content of isothiocyanates, alkaloids and phenolic acids — pungent, penetrating, biologically reactive molecules — while its *Kapha–Vatahara* action is broadly consistent with its digestive-stimulant and mild stimulant cardiovascular effects reported in pharmacological studies.[20,21,22,23] The present pharmacognostical study contributes objective, reproducible identity markers for *Shigru phala* that have previously been under-represented relative to the leaf and seed: the diagnostic transverse-section anatomy (thin epicarp, fibrous-vascular mesocarp, sclerenchymatous endocarp), the powder-microscopic elements (stone cells, pitted vessels, calcium oxalate crystals), and a defined set of physicochemical constants (foreign matter 1.59%, loss on drying 4.0%, pH 6.2, acid-insoluble ash 6.66%, water-soluble ash 0.87%, and extractive values ranging from 3.98% in water to 42.92% in methanol).

The comparatively high methanolic extractive value and the confirmed presence of alkaloids, flavonoids, sterols and (in aqueous/methanolic extracts) tannins together with the seven resolved TLC spots (Rf 0.14–0.75) provide a preliminary chromatographic fingerprint that may be extended, in future work, with high-performance thin-layer chromatography (HPTLC) and marker-compound quantification (e.g., of chlorogenic acid or quercetin derivatives) for a more rigorous pharmacopoeial monograph. A limitation of the present analytical study is that observations are based on a single representative sample set; multi-batch and multi-source validation, along with heavy-metal, microbial-load and pesticide-residue testing, would be required before the values proposed here could be adopted as formal pharmacopoeial limits.[27,46,48]

9. Conclusion

Shigru (*Moringa oleifera* Lam.) is a classically well-characterised and pharmacologically well-supported *Ayurvedic* drug whose *phala*

(pod) has, until now, lacked a consolidated pharmacognostical profile. The present review-cum-analytical study brings together its *Nirukti*, synonyms, classification, *Rasapanchaka* and *Rogaghnata* with an original macroscopic, microscopic, physicochemical, phytochemical and chromatographic evaluation of the pod. The compiled organoleptic characters, anatomical markers, physicochemical constants and TLC Rf values are proposed as preliminary reference standards to aid the identification, authentication and quality control of *Shigru phala* in future research, pharmacopoeial and industrial applications.

References

1. Agnivesha. Charaka Samhita, Sutra Sthana 9/3, revised by Charaka and Dridhabala with the Ayurveda-Dipika commentary of Cakrapanidatta and Vidyotini Hindi commentary by Kashinatha Sastri and Gorakha Natha Chaturvedi. Varanasi: Chaukhambha Bharati Academy; Reprint 2006. p.132.
2. World Health Organization, IUCN, WWF. Guidelines on the Conservation of Medicinal Plants. Gland, Switzerland: IUCN; 1993;1:4–6.
3. Bhagwati U. Utilization of medicinal plants by the rural women of Kulu, Himachal Pradesh. Indian J Trad Know. 2003;2:366–70.
4. Government of India, Ministry of AYUSH. The Ayurvedic Pharmacopoeia of India, Part I, Vol. I. New Delhi; 2001. p.146–148.
5. World Health Organization. Quality Control Methods for Medicinal Plant Materials. Geneva: WHO; 1998.
6. Agnivesha, Sushruta, Vagbhata. Charaka Samhita, Sutra Sthana 1/135 (Chaukhambha Bharati Academy, Varanasi, Reprint 2001); Sushruta Samhita with Ayurveda Tattva Sandeepika Hindi commentary by Ambikadutta Shastri (Chaukhambha Sanskrit Sansthan, Varanasi, Reprint 2006); Ashtanga Hridaya, edited with Vidyotini Hindi commentary by Kaviraja Atrideva Gupta (Chaukhambha Sanskrit Sansthan, Varanasi, 13th ed. 2000).
7. Hegde PL, Harini A. A Textbook of Dravyaguna Vijnana. Vol. 2. New Delhi: Chaukhamba Publications; Revised ed. 2022. p.646–647.
8. Bhavamishra. Bhavaprakasha Nighantu, commented by K.C. Chunekar, edited by G.S. Pandey. Varanasi: Chaukhambha Bharati Academy; Reprint 2022. Guduchyadi Varga, p.324–325.
9. Bapalal Vaidya G. Nighantu Aadarsha, Vol. I. Varanasi: Chaukhamba Bharati Academy; 2013.
10. Pandit Narhari. Raja Nighantu, edited by Indradeva Tripathi. Varanasi: Chowkhambha Krishnadas Academy; 2006. p.193.
11. Prajapati N, Purohit SS, Sharma AK, Kumar T. A Handbook of Medicinal Plants. Jodhpur: Agrobios (India); 2007. p.350–351.
12. Kirtikar KR, Basu BD. Indian Medicinal Plants. 2nd ed. Dehra Dun: International Book Distributors; 1999. Vol. I. p.676–683.
13. Nadkarni KM. Indian Materia Medica. Vol. 1. Bombay: Popular Prakashan; 2009. p.811–816.
14. Sharma PC, Yelne MB, Dennis TJ. Database on Medicinal Plants Used in Ayurveda. Vol. 1. Reprint. New Delhi: Central Council for Research in Ayurvedic Sciences (CCRAS); 2002. Shigru, p.431.
15. Dhyani SC. Dravyaguna Siddhanta. Varanasi: Chaukhamba Krishnadas Academy; 2014.
16. Cushnie TPT, Cushnie B, Lamb AJ. Alkaloids: an overview of their antibacterial, antibiotic-enhancing and antivirulence activities. Int J Antimicrob Agents. 2014;44:377–386; Kasolo JN, Bimenya GS, Ojok L, Ochieng J, Ogwal-Okeng JW. Phytochemicals and uses of Moringa oleifera leaves in Ugandan rural communities. J Med Plant Res. 2010;4:753.
17. Rockwood JL, Anderson BG, Casamatta DA. Potential uses of Moringa oleifera and an examination of antibiotic efficacy conferred by M. oleifera seed and leaf extracts using crude extraction techniques available to under-served indigenous populations. Int J Phytother Res. 2013;3:61–71.
18. Fuglie LJ. The Moringa Tree: A Local Solution to Malnutrition. Dakar: Church World Service; 2001.
19. Agnivesha. Charaka Samhita, Sutra Sthana 1/126, revised by Charaka and Dridhabala with the Ayurveda-Dipika commentary of Cakrapanidatta. Varanasi: Chaukhambha Sanskrit Bhawan; Reprint 2018.
20. Pareek A, Pant M, Gupta MM, Kashania P, Ratan Y, Jain V, Pareek A, Chuturgoon AA. Moringa oleifera: an updated comprehensive review of its pharmacological activities, ethnomedicinal, phytopharmaceutical formulation, clinical, phytochemical, and

toxicological aspects. Int J Mol Sci. 2023;24(3):2098.

21. Azlan UK, Mediani A, Rohani ER, Tong X, Han R, Misnan NM, Jam FA, Bunawan H, Sarian MN, Hamezah HS. A comprehensive review with updated future perspectives on the ethnomedicinal and pharmacological aspects of Moringa oleifera. Molecules. 2022;27(18):5765.

22. Bhattacharya A, Tiwari P, Sahu PK, Kumar S. A review of the phytochemical and pharmacological characteristics of Moringa oleifera. J Pharm Bioallied Sci. 2018;10(4):181–191.

23. Camilleri E, Blundell R. A comprehensive review of the phytochemicals, health benefits, pharmacological safety and medicinal prospects of Moringa oleifera. Heliyon. 2024;10(6):e27807.

24. Kalappurayil TM, Joseph BP. A review of pharmacognostical studies on Moringa oleifera Lam. flowers. Pharmacogn J. 2017;9(1):1–7.

25. Peter EL, et al. Genetic and therapeutic properties of Moringa oleifera. Pharmacogn Rev. 2023;17(34):426–438.

26. Thorat VH, Rangari DT. Pharmacognostic account and phytochemical studies of Moringa oleifera Lam. Int J Pharmacogn (IJP). 2018;5(5):304–312.

27. Bauer R. Quality criteria and standardization of phytopharmaceuticals: can acceptable drug standards be achieved? Drug Inf J. 1998;32:101–110.

28. Misra A, Srivastava M, Rawat AKS. Standardization of Moringa oleifera Lam. Leaves: Pharmacognostic and Phytochemical Evaluation of Leaves as Nutrition Supplement. Saarbrücken: LAP LAMBERT Academic Publishing.

29. Anwar F, Latif S, Ashraf M, Gilani AH. Moringa oleifera: a food plant with multiple medicinal uses. Phytother Res. 2007;21(1):17–25.

30. Amagloh FK, Benang A. Effectiveness of Moringa oleifera seed as coagulant for water purification. Afr J Agric Res. 2009;4(2):119–123.

31. Bhuptawat H, Folkard GK, Chaudhari S. Innovative physico-chemical treatment of waste water incorporating Moringa oleifera seed coagulant. J Hazard Mater. 2007;142(1–2):477–482.

32. Ndabigengesere A, Narasiah KS, Talbot BG. Active agents and mechanism of coagulation of turbid waters using Moringa oleifera. Water Res. 1995;29(2):703–710.

33. Ndabigengesere A, Narasiah KS. Quality of water treated by coagulation using Moringa oleifera seeds. Water Res. 1998;32(3):781–791.

34. Yuliastri IR, Rohaeti E, Effendi H, Darusman LK. The use of Moringa oleifera seed powder as coagulant to improve the quality of wastewater and ground water. IOP Conf Ser Earth Environ Sci. 2016;31:012033.

35. Tunggolou J, Payus C. Application of Moringa oleifera plant as water purifier for drinking water purposes. J Environ Sci Technol. 2017;10:268–275.

36. Makky EA, Ali EN. The use of Moringa oleifera seed as a natural coagulant for wastewater treatment and heavy metals removal. Appl Water Sci. 2016;6:507–512.

37. Nkukwana TT, Muchenje V, Pieterse E, Masika PJ, Mabusela TP, Hoffman LC. Effect of Moringa oleifera leaf meal on growth performance, apparent digestibility, digestive organ size and carcass yield in broiler chickens. Livest Sci. 2014;161:139–146.

38. Mahfuz S, Piao XS. Application of Moringa (Moringa oleifera) as natural feed supplement in poultry diets. Animals (Basel). 2019;9(7):431.

39. Alabi OJ, Malik AD, Ng'ambi JW, Obaje P, Ojo BK. Effect of aqueous Moringa oleifera (Lam) leaf extracts on growth performance and carcass characteristics of Hubbard broiler chicken. Braz J Poult Sci. 2017;19(2):273–280.

40. Jabeen R, Shahid M, Jamil A, Ashraf M. Microscopic evaluation of the antimicrobial activity of seed extracts of Moringa oleifera. Pak J Bot. 2008;40(4):1349–1358.

41. Luqman S, Srivastava S, Kumar R, Maurya AK, Chanda D. Experimental assessment of Moringa oleifera leaf and fruit for its antistress, antioxidant and scavenging potential using in vitro and in vivo assays. Evid Based Complement Alternat Med. 2012;2012:519084.

42. Bhadresha K, Thakore V, Brahmbhatt J, Upadhyay V, Jain N, Rawal R. Anticancer effect of Moringa oleifera leaves extract against lung cancer cell line via induction of apoptosis. Adv Cancer Biol Metastasis. 2022;6:100072.

43. El-Sherbiny GM, Alluqmani AJ, Elsehemy IA, Kalaba MH. Antibacterial, antioxidant, cytotoxicity, and phytochemical screening of Moringa oleifera leaves. Sci Rep. 2024;14:30485.

44. Jeganathan NS, Kannan K. HPTLC method for estimation of ellagic acid and gallic

acid in Triphala churnam formulations. Res J Phytochem. 2008;2(1):1–9.

45. Reich E, Blatter A. Handbook of Thin-Layer Chromatography. 3rd ed. In: Sherma J, Fried B, editors. New York: Marcel Dekker; 2003.

46. World Health Organization. WHO Traditional Medicine Strategy 2014–2023. Geneva: World Health Organization; 2013.

47. Indian Pharmacopoeia Commission. Indian Pharmacopoeia. Ghaziabad: Indian Pharmacopoeia Commission.

48. International Conference on Harmonisation (ICH). Q2(R1): Validation of Analytical Procedures — Text and Methodology. Geneva: ICH; 2005.

49. Sharma PV. Dravyaguna Vijnana, Vol. II. Varanasi: Chaukhambha Bharati Academy.

50. Khare CP, editor. Indian Medicinal Plants: An Illustrated Dictionary. New York: Springer; 2007.

51. Kokate CK, Purohit AP, Gokhale SB. Pharmacognosy. Pune: Nirali Prakashan.

52. Evans WC. Trease and Evans' Pharmacognosy. 16th ed. Edinburgh: Saunders Elsevier.

53. Mukherjee PK. Quality Control and Evaluation of Herbal Drugs: Evaluating Natural Products and Traditional Medicine. Amsterdam: Elsevier.

54. Wallis TE. Textbook of Pharmacognosy. 5th ed. New Delhi: CBS Publishers.

55. Chopra RN, Nayar SL, Chopra IC. Glossary of Indian Medicinal Plants. New Delhi: CSIR; 1956.

56. Council of Scientific and Industrial Research. The Wealth of India: Raw Materials, Vol. VI. New Delhi: CSIR; 1962.

57. Siddhuraju P, Becker K. Antioxidant properties of various solvent extracts of total phenolic constituents from three different agroclimatic origins of drumstick tree (Moringa oleifera Lam.) leaves. J Agric Food Chem. 2003;51(8):2144–2155.

58. Makkar HPS, Becker K. Nutritional value and antinutritional components of whole and ethanol extracted Moringa oleifera leaves. Anim Feed Sci Technol. 1996;63(1–4):211–228.

59. Fahey JW. Moringa oleifera: a review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. Part 1. Trees Life J. 2005;1:5.

60. Ramachandran C, Peter KV, Gopalakrishnan PK. Drumstick (Moringa oleifera): a multipurpose Indian vegetable. Econ Bot. 1980;34(3):276–283.

61. Su B, Chen X. Current status and potential of Moringa oleifera leaf as an alternative protein source for animal feeds. Front Vet Sci. 2020;7:53.

62. Nair S, Varalakshmi KN. Anticancer, cytotoxic potential of Moringa oleifera extracts on HeLa cell line. J Nat Pharm. 2011;2(3):138–142.

63. Khor KZ, Lim V, Moses EJ, Abdul Samad N. The in vitro and in vivo anticancer properties of Moringa oleifera. Evid Based Complement Alternat Med. 2018;2018:1071243.

64. Sofowora A. Medicinal Plants and Traditional Medicine in Africa. 3rd ed. Ibadan: Spectrum Books; 2008.

65. WHO Regional Office for the Western Pacific. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines. Manila: WHO; 1993.