

Valorisation of Medicinal Plants in Mauritius for their Potential Application in Ayurvedic Formulations



UNIVERSITY OF
MAURITIUS



Meet the team



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CCRAS TEAM
21 researchers



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Ayurveda in a changing global health landscape

1

Strengthen the Evidence Base

Rigorous research to substantiate traditional claims.

2

Ensure Safety, Quality & Regulation

Minimum standards for plant materials and practitioners.

3

Integrate into Health Systems

Appropriate, context-specific incorporation alongside conventional medicine.

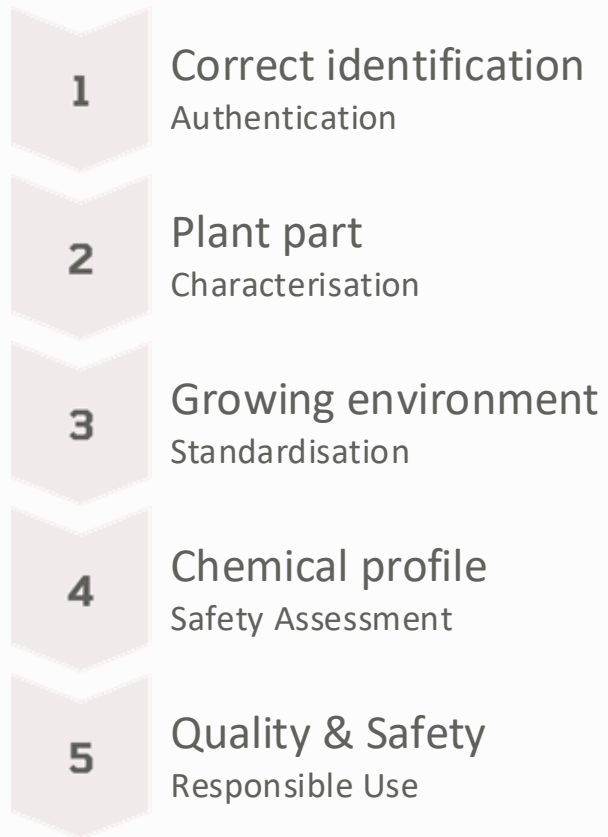
4

Optimise Cross-Sectoral Value



In herbal medicine, knowing the plant matters

The botanical name alone does not fully define the medicinal material. A layered chain of evidence - from identity to safety is required before any plant can be responsibly used.



Traditional knowledge identifies valuable resources. Scientific characterisation establishes what is actually being used.

Same species ≠ Same phytochemical profile

Geography and cultivation conditions profoundly shape the chemistry of medicinal plants. Environmental variables drive meaningful differences in the concentration and profile of bioactive constituents.

Mauritius-specific reference data are essential — locally grown material cannot be assumed equivalent to pharmacopoeial reference standards derived elsewhere.

"Natural" does not automatically mean "safe"

Safety depends on the plant material, its composition, handling, and quality controls applied throughout the supply chain.

Potential Value

- Bioactive constituents with therapeutic relevance
- Documented traditional therapeutic use
- Potential for formulation research
- Local cultivation and innovation opportunity

Potential Safety Concerns

- Intrinsic toxic constituents in some species
- Heavy metal and pesticide residues
- Microbial and aflatoxin contamination
- Adulteration or substitution of plant material
- Inappropriate plant part or processing method

Scientific analysis helps distinguish assumption from evidence. WHO Ayurveda benchmarks emphasise minimum reference standards for safety, quality assurance, and regulation.

Why Scientific Analysis Matters

A chain of evidence is required to move from a plant resource to a quality-assured medicinal material.



Authenticate

Characterise

Fingerprint

Test Safety

Standardise

Why Mauritius? From Biodiversity to a Knowledge-Based Bioeconomy

Local cultivation creates value when coupled with science, standards, and sustainability.

Cultivate

Selected medicinal crops under traceable, local growing conditions

Characterise

Mauritius-specific profiles and reference fingerprints

Innovate

Formulation research and value-added product development

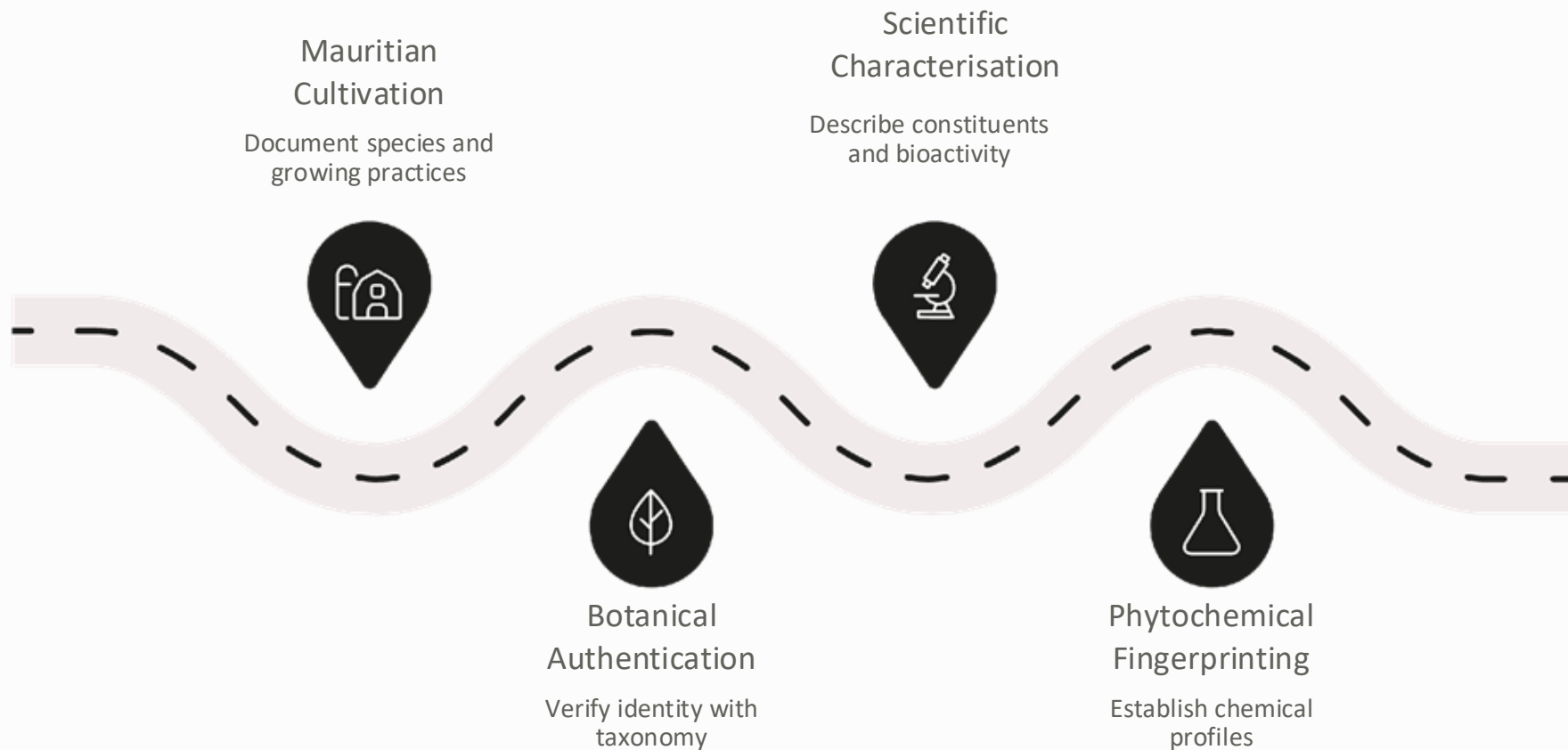
Sustain

Responsible cultivation, biodiversity stewardship, and skills development



From Medicinal Plant to National Opportunity

A pathway for responsible valorisation in Mauritius from field to evidence base.



Valorisation begins with knowing what we grow, understanding what it contains, establishing appropriate quality and safety parameters, and building the evidence required for responsible use.

Longer-term opportunity: a Mauritius-specific scientific repository and evidence base to support medicinal plant standards and future pharmacopoeial development.



Context

Deep Cultural Roots

Ayurveda is among the world's most ancient healthcare systems and is innate to the Mauritian population of Indian origin, recognised under *The Ayurveda & Other Traditional Medicine Act 37 of 1989*, Republic of Mauritius.

Pharmacopoeia Yet to be Developed

An Ayurvedic Pharmacopoeia of Mauritius has not yet been established — this project contributes foundational evidence towards that goal.

Ancient Wisdom

"Na anoushadhibhootam jagati kinchit dravyamupalabhyate" (Charak Samhita) — there is no substance in the world that is not a medicine. This project operationalises that wisdom through science.

National Mandate

Aligned with the MRIC National Roadmap for Research & Innovation 2023–2027, Section 8.3.8 — Ayurveda & Traditional Medicine.

Aims and Objectives

1

Quality Standards

Establish quality standards -identification, purity, and strength for selected plant species grown in Mauritius.

2

Marker Compound Repository

Create an authentic reference repository for marker compounds in the selected plant species.

3

Ethnobotanical Survey

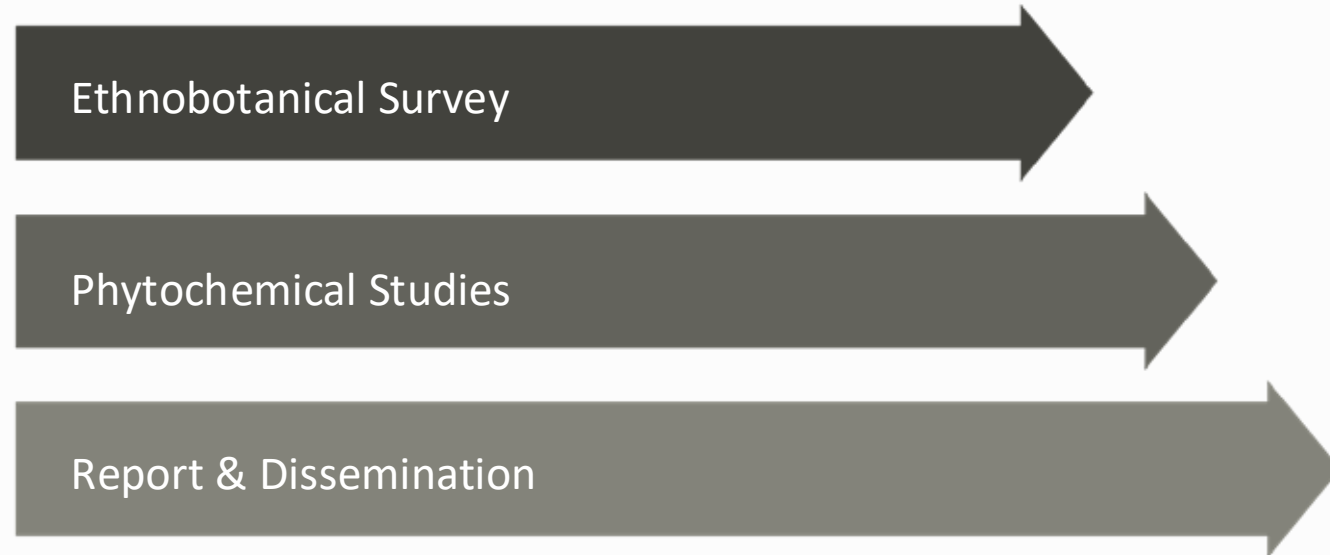
Conduct a structured ethnobotanical survey covering 80 plant species.

4

Phytochemical Standardisation

Perform phytochemical standardisation with validated marker compounds for 14 priority plant species.

Methodology



Key Activities

- **Field work:** Ethnobotanical survey of 80 plant species. Collection of specimens; preparation of herbarium sheets.
- **Laboratory work:** Drying & processing of samples. Phytochemical standardisation with marker compounds for 14 herbs
- **Report writing:** Compilation, comparison with API standards, and monograph preparation

Field Collection — Plant Material from Mauritius

Specimens collected from cultivation sites and natural habitats across Mauritius, representing key Ayurvedic species



Herbarium Sheets



Validated Voucher Specimens

Herbarium sheets were prepared for all surveyed species as permanent, voucher records — a critical component of botanical identity and traceability.

The full herbarium collection is accessible at:

[View Herbarium Collection](#)

Social, economic, and scientific impact



Social

Improved public awareness of locally available medicinal herbs. Greater community knowledge supporting preventive health and immunity.



Economic

Reduced burden on healthcare infrastructure. *Tulasi* cultivation demonstrated to be 1.5× more profitable than sugarcane — a compelling case for agricultural diversification.

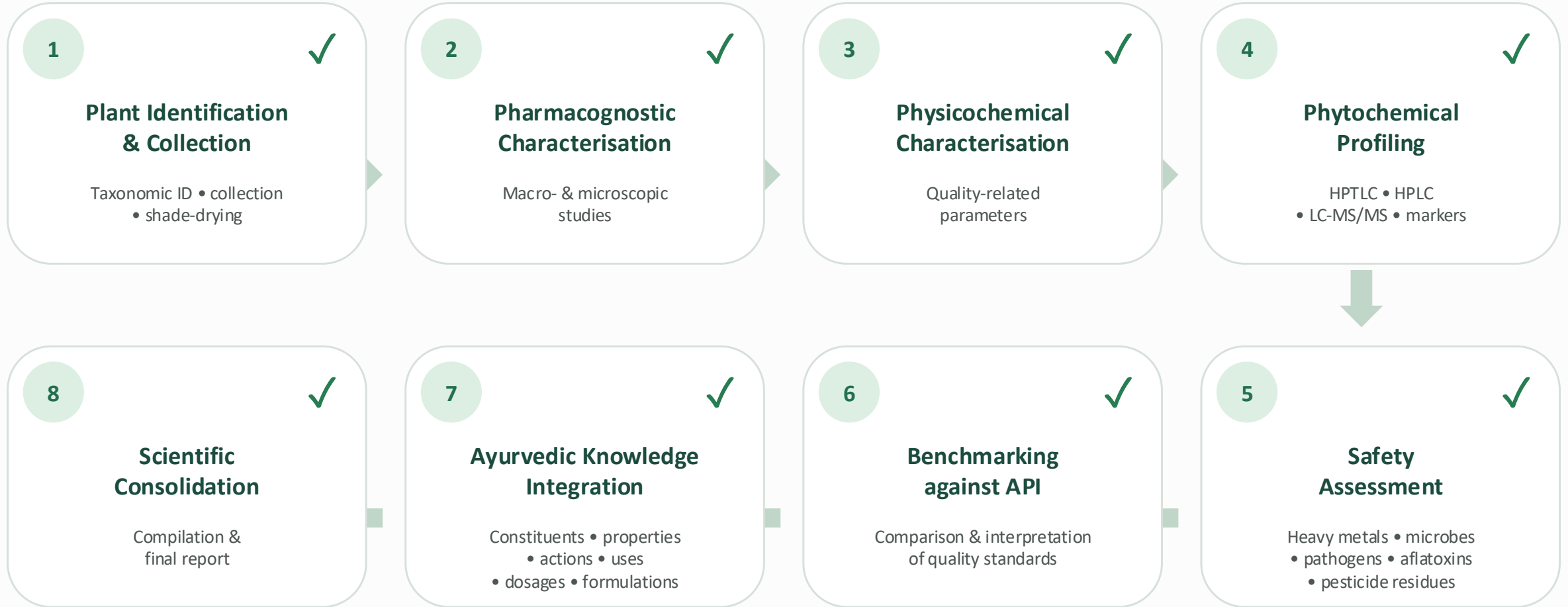


Scientific

Two public communications produced: one for the general public, one for Ayurveda practitioners.
Comparison of marker compounds across geographies.



Results — All Objectives Achieved



Work Completed and Deliverables



Key Research Finding

14 quality monographs were prepared, comparing Mauritian-sourced specimens with Ayurvedic Pharmacopoeial standards.

Monographs were compiled and reported through CCRAS, establishing a foundational evidence base for a future Ayurvedic Pharmacopoeia of Mauritius.

14 Plant Species Selected for Phytochemical Study

No.	Plant Name	Useful Part
1.	<i>Aegle marmelos</i> (L.) Corrêa	Pulp of entire fruit
2.	<i>Azadirachta indica</i> A. Juss.	Dried leaf
3.	<i>Bauhinia variegata</i> L.	Dried stem bark
4.	<i>Cissus quadrangularis</i> L.	Dried stem
5.	<i>Curcuma longa</i> L.	Dried rhizome
6.	<i>Moringa oleifera</i> Lam.	Dried leaf
7.	<i>Ocimum tenuiflorum</i> L.	Leaves, stem, and petiole
8.	<i>Emblica officinalis</i> Gaertn.	Pericarp excluding endocarp
9–10.	<i>Plumbago zeylanica</i> L.	Dried root; dried leaf
11.	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Dried stem bark
12.	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Dried fruit
13.	<i>Tinospora cordifolia</i> (Willd.) Hook.f. & Thomson	Dried stem
14.	<i>Zingiber officinale</i> Roscoe (Sonth)	Dried rhizome

Ayurvedic Pharmacopoeia of India (API)

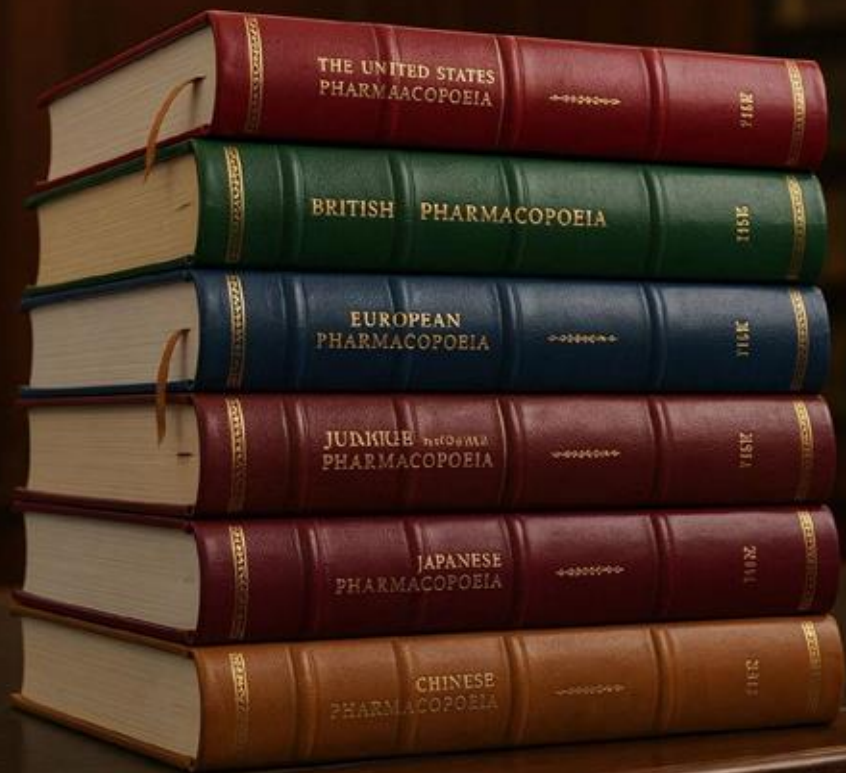
The API is the official compendium of quality standards for Ayurvedic medicines, operating under the Drugs and Cosmetics Act, 1940, through the Ministry of Ayush and the Pharmacopoeia Commission for Indian Medicine & Homoeopathy.

Part I — Single Drugs

Covers raw materials of natural origin — plants, minerals, animal parts. Contains **multiple volumes with 645 monographs** on individual drug substances.

Part II — Compound Formulations

Covers classical multi-ingredient formulas derived from ancient Ayurvedic texts. Provides tests and standards for **202 compound formulation monographs**.



Typical Monograph Contents

01

Title & Synonyms

Botanical, common, and regional language names

02

Macroscopic / Microscopic Description

Morphological and cellular characteristics

03

Identity, Purity & Strength

Foreign matter, ash values, extractive values

04

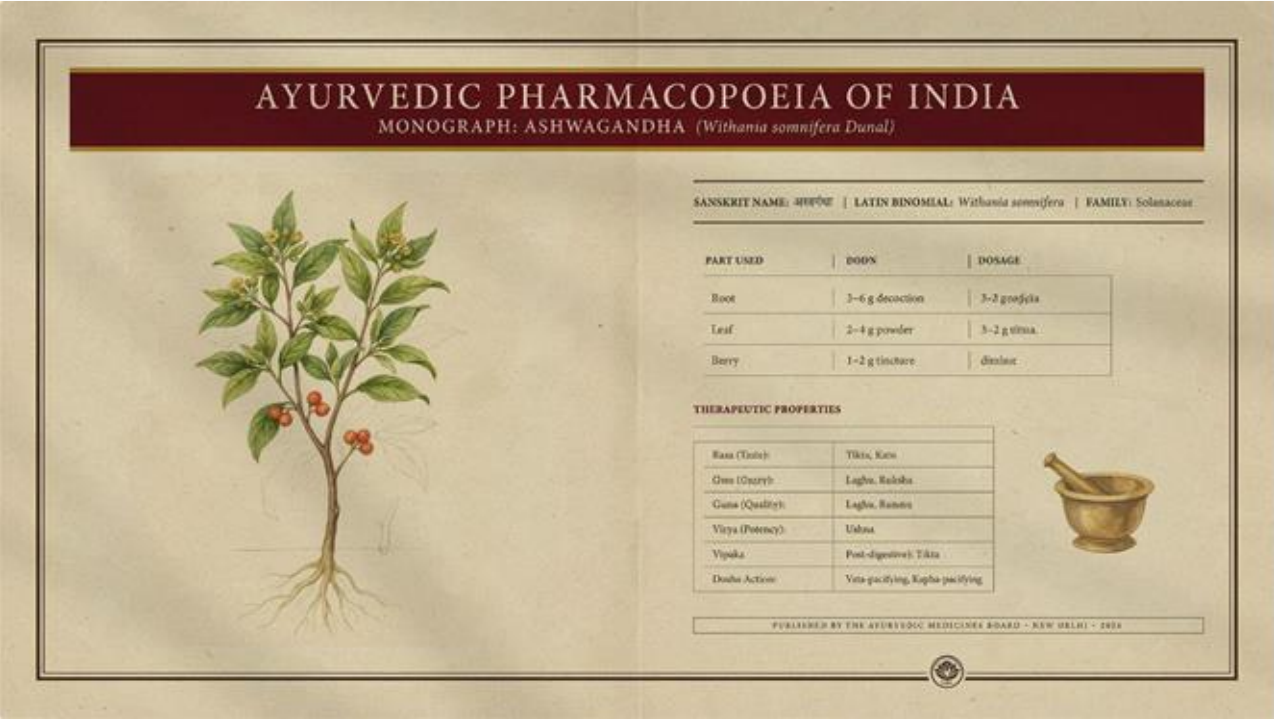
Assays, Tests & Constituents

Marker compound quantification and safety tests

05

Properties, Actions & Therapeutic Use

Ayurvedic properties, formulations, dose





Species example for the Ayurvedic Pharmacopoeia of Mauritius

Demonstrating how the findings align with and supplement the *Ayurvedic Pharmacopoeia of India* — using *Amalaki / Emblica officinalis* Gaertn. as the worked example.

CASE STUDY

Amalaki (*Emblica officinalis* Gaertn.) — one of Ayurveda's most celebrated Rasayana herbs, used in formulations including Cyavanaprash and Triphala.

API — Amalaki: Definition and Synonyms

AMALAKI (Fresh Fruit Pulp) consists of the fresh fruit pulp of *Emblica officinalis* Gaertn. (Phyllantaceae); a small to medium-sized tree found in mixed deciduous forests, growing up to 1,300 m, and widely cultivated.

Selected Regional Synonyms

Sanskrit

Āmalaka, Amṛtaphala,
Dhātṛīphala

Hindi

Amla, Aonla

English

Emblic Myrobalan

Tamil

Nellikai, Nelli

Malayalam

Nellikka

Gujarati

Aavla, Ambala. Amali

Telugu

Usirika

Creole

Amla, Groseille indienne

API — Amalaki: macroscopic description



Macroscopic features

Fruit globose, 2.5–3.5 cm diameter, fleshy, smooth with **six prominent ridges**; greenish when tender, turning light yellowish or pinkish at maturity with occasional dark specks. Taste: sour and astringent, followed by a delicately sweet note.

Microscopic features

Transverse section shows a single-layered epidermis with 2–4 hypodermal layers; parenchymatous mesocarp with scattered collateral fibrovascular bundles; xylem with reticulate, scalariform, and spiral thickenings; large aggregates of irregular silica crystals throughout the mesocarp.

API Amalaki: Identity, Purity & Strength

Parameter	API Limit
Foreign matter	NMT 2%
Total ash	NMT 7%
Acid-insoluble ash	NMT 2%
Alcohol-soluble extractive (dried basis)	NLT 40%
Water-soluble extractive	NLT 50%
Moisture content	NLT 80%



Key Constituents: Ascorbic acid (Vitamin C) and tannins - the primary quality marker compounds for this plant.

API Amalaki: Properties, Actions & Therapeutic Use

Ayurvedic Properties

Rasa

Amla, Kaṣāya,
Madhura, Tikta, Katu

Guṇa

Rūkṣa, Laghu

Vīrya

Śīta (cooling)

Vipāka

Madhura

Karma

Tridoṣajit, Varṇya, Rasāyana, Cakṣuṣya

Therapeutic Uses

- Raktapitta (bleeding disorders)
- Amlapitta (hyperacidity)
- Prameha (metabolic disorders)
- Dāha (burning sensations)

Important Formulations

Cyavanaprash, Triphala

Dose

3–6 g of drug; 5–10 ml of fresh juice

Monograph

Emblica officinalis Gaertn.: Definition & Description



Definition

Amalaki consists of the pericarp excluding endocarp of *Emblica officinalis* Gaertn. (Phyllantaceae), collected in winter after ripening. Native to India; also found in Pakistan, Uzbekistan, Sri Lanka, Southeast Asia, China, and Malaysia. Cultivated in Mauritius.

Macroscopy

Drug comprises curled pieces of pericarp, 1–2 cm long or as 3–4 joined segments; colour grey to black; exterior surface severely shrivelled and wrinkled; taste sour and astringent; texture rough, cartilaginous, and tough.

Microscopy — *Emblica officinalis*

Transverse Section

Epicarp: single-layered epidermis, tubular and polygonal; cuticle present. Mesocarp: tangentially elongated, parenchymatous, crushed cells — 8–9 peripheral layers of smaller cells surrounding larger isodiametric cells with irregularly thickened walls and starch grains. Ramified vascular components and stone cells (alone or in clusters) with pitted vascular fibres are occasionally present.

Powder Microscopy

Shows isodiametric parenchyma with irregularly thickened walls; short fibres and tracheids; epidermis with uniformly thickened straight walls; isolated or grouped thin-walled pitted stone cells; fragments of pitted vessels, tracheids, and parenchyma; thick-walled fibres and sclereids; silica crystals; simple oval-to-spherical starch grains in mesocarp parenchyma. Powder colour: greyish to black.

Physicochemical profiling — *Emblica officinalis*

Table 1: Identity, Purity and Strength parameters with Mauritius results compared against API permissible limits.

No.	Parameter	Result (Mauritius)	API Limit
1.	Loss on Drying at 105°C (w/w %)	7.19	NLT 8%
2.	Total Ash at 600°C (w/w %)	3.495	NMT 7%
3.	Acid-insoluble ash (w/w %)	0.065	NMT 2%
4.	Alcohol-soluble extractive (w/w %)	13.63	NLT 40%
5.	Water-soluble extractive (w/w %)	32.91	NLT 50%
6.	pH value (10% w/v aqueous extract)	2.40	—

Phytochemical analysis — *Emblica officinalis*

Table 2: Quantitative phytochemical profile of Mauritius-sourced *Emblica officinalis*

Parameter	Result	API Limit
Total Phenolic Content (mg/g GAE)	125.71	—
Total Flavonoid Content (mg/g QE)	97.06	—

Significance

Both phenolic and flavonoid content values are documented as **minimum permissible limits** for Mauritius-sourced material — establishing locally derived baseline standards where no API reference currently exists.

These values contribute directly to the development of a Mauritius-specific pharmacopoeial monograph for the species.

HPTLC Fingerprint Analysis — *Emblica officinalis*

High-Performance Thin Layer Chromatography was conducted on methanolic extract (soxhlet extraction, 24 hrs at 70°C). Reference standards applied: Vitamin C (Track 1) and Phyllanthin (Track 2); extract on Track 3. Plate: Silica gel 60 F254 (E. Merck, 0.2 mm). Solvent system: **Toluene : Ethyl Acetate : Methanol : Formic Acid (4.5 : 2 : 2 : 1)**.

- ❏ HPTLC fingerprinting provides a characteristic chromatographic "signature" enabling identity confirmation and batch-to-batch consistency monitoring - a key tool for pharmacopoeial standardisation.

HPTLC Results — UV 254 nm & UV 366 nm

Table 3: Rf values of HPTLC chromatogram tracks for *Emblica officinalis* at UV 254 nm and UV 366 nm.

UV 254 nm (Track 3 — Extract)

Peak	Rf	Colour
1	0.08	Grey
2	0.11	Black
3	0.21	Grey
4	0.25	Light Grey
5	0.37	Grey
6	0.51	Black
7	0.56	Grey
8	0.60	Grey

UV 366 nm (Track 3 — Extract)

Peak	Rf	Colour
1	0.08	Blue
2	0.11	Dark Blue
3	0.21	Dark Blue
4	0.25	Light Blue
5	0.37	Light Blue
6	0.41	Light Blue
7	0.51	Dark Blue
8	0.60	Light Blue

HPTLC Results - After Derivatisation

Post-derivatisation chromatogram reveals additional bands, particularly violet zones indicative of phenolic and tannin constituents consistent with the known phytochemical profile of *Emblica officinalis*.

Peak	Rf (Track 3 — Extract)	Colour
1	0.11	Dark Brown
2	0.21	Brown
3	0.25	Light Brown
4	0.44	Violet
5	0.48	Violet
6	0.56	Violet
7	0.60	Light Yellow
8	0.64	Violet
9	0.80	Blue

Track 1 (Vitamin C) showed a brown band at Rf 0.25; Track 2 (Phyllanthin) showed a yellow band at Rf 0.60 — confirming presence of equivalent zones in the extract.

Safety Evaluation — Heavy metals & aflatoxins

All heavy metal and mycotoxin parameters for Mauritius-sourced *Emblica officinalis* were found to be below quantification limits (BQL), meeting international permissible standards.

Heavy Metals

Metal	Result	Limit (mg/kg)
Lead	BQL	10.0
Arsenic	BQL	0.30
Mercury	BQL	1.00
Cadmium	BQL	3.00

Aflatoxins

Parameter	Result	Limit
B1 + B2 + G1 + G2	BQL	2.0–5.0 mcg/kg
B1 (individual)	BQL	2.0 mcg/kg

✔ All safety parameters comply with permissible limits — confirming the material is safe for pharmaceutical use.

Pesticide Residue Analysis - *Emblica officinalis*

No.	Pesticide	Result	Limit (mg/kg)
1.	Dithiocarbamates	BQL	2.0
2.	Malathion	BQL	1.0
3.	Phosalone	BQL	0.10
4.	Pyrethrins	BQL	3.0
5.	Alachlor	BQL	0.020
6.	Ethion	BQL	2.0
7.	Chlorpyrifos	BQL	0.20
8.	Methyl Parathion	BQL	0.20
9.	Lindane	BQL	0.60
10.	Dichlorvos	BQL	1.0
11.	Endrin	BQL	0.050
12.	Fonofos	BQL	0.050
13.	Methidathion	BQL	0.20
14.	Azinophos-methyl	BQL	1.0
15.	Bromopropylate	BQL	3.0
16.	Chlorpyrifos-methyl	BQL	0.10
17.	Deltamethrin	BQL	0.50
18.	Diazinon	BQL	0.50
19.	Parathion	BQL	0.50
20.	Paramethrin	BQL	1.0
21.	Pirimiphos-methyl	BQL	4.0
22.	Fenitrothion	BQL	0.50
23.	Piperonyl-butoxide	BQL	3.0
24.	Endosulfan (alpha, beta & sulphate)	BQL	3.0
25.	Hexachlorobenzene (HCB)	BQL	0.10
26.	Chlorfenvinphos	BQL	0.50
27.	Fenvalerate	BQL	1.50
28.	Aldrin and Dieldrin	BQL	0.050
29.	Chlordane	BQL	0.050
30.	Hexachlorocyclohexane	BQL	1.0
31.	Quintozone	BQL	0.30
32.	Cypermethrin	BQL	1.0
33.	Heptachlor	BQL	0.050

All 33 pesticide residues were Below Quantification Limits — confirming full compliance across an extensive safety screen.



Conclusions & the Road Ahead

All Eight Objectives Met

Every planned deliverable - from botanical authentication to safety evaluation — was successfully completed and documented within the project period.

14 Quality Monographs Established

Monographs prepared for Mauritius-grown specimens and benchmarked against API standards, providing the first locally anchored reference data for these herbs.

Foundation for a Mauritian Pharmacopoeia

This work constitutes the groundwork for a future *Ayurvedic Pharmacopoeia of Mauritius* — translating biodiversity into a nationally recognised evidence base.

A Model for Knowledge-Based Valorisation

Coupling local cultivation with rigorous science creates durable value - for agriculture, public health, research, and Mauritius's emerging bioeconomy.

Sensitisation and Knowledge Dissemination to Ayurveda Practitioners and the General Public

Acknowledgements



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Thank You

