



Review Article

A REVIEW ON STANDARDIZING MAMAJJAKA (*Enicostema Axillare* POIR.EX.LAM): INTEGRATING TRADITIONAL DRAVYAGUNA PRINCIPLES WITH MODERN PHARMACOGNOSTICAL TOOLS

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ABSTRACT

Mamajjaka (*Enicostema axillare*), or *Mamejavo*, is a potent bitter plant of Gujarat's ethno-medicine especially in Sourashtra region, traditionally used for *Madhumeha* (diabetes), *Jwara* (fever), and *Yakrut-Vikara* (hepatic disorders). However, commercial adulteration within the Gentianaceae family often compromises its therapeutic efficacy. **Objective:** This study establishes definitive pharmacognostical and phytochemical standards to ensure the quality, safety, and authenticity of *E. axillare*. **Methodology:** A comparative analysis was conducted using traditional texts (*Shodhala Nighantu*, API) and modern databases. The research synthesized macroscopic, microscopic, and advanced analytical data, including HPTLC and GC-MS fingerprinting. **Discussion:** Key diagnostic markers identified include intra-xylary phloem and specific stomatal patterns. The secoiridoid glycoside 'Swertiamarin' was confirmed as the primary chemical marker for authentication. These high-tech parameters validate the plant's traditional use with scientific precision. **Conclusion:** Ensuring the genuinity of *Mamajjaka* is vital for the global credibility of Ayurveda. This paper proposes a "Digital *Dravyaguna* Repository" for Gujarat's local flora, utilizing precise phytochemical markers to meet international safety and toxicity standards.

INTRODUCTION

Recent decades have witnessed a substantial increase in the global utilisation of herbal medicines and traditional healthcare products^[1]. However, the therapeutic reliability of many extra-pharmacopeial and ethnomedicinal plants remains inadequately explored due to insufficient pharmacognostical documentation, lack of phytochemical profiling, and absence of validated authentication standards^[2]. In this context, detailed scientific evaluation of regionally important drugs such as *Mamajjaka* becomes highly essential.

Despite its widespread traditional use in Gujarat folk medicine and Ayurveda practice, *Mamajjaka* still remains underrepresented in major pharmacopeial monographs and standardization protocols. Such gaps increase the possibility of substitution, adulteration, and inconsistency in therapeutic outcomes. Therefore, systematic pharmacognostical, phytochemical, and analytical studies are necessary to establish the identity, purity, and therapeutic credibility of these extra-pharmacopeial medicinal plants.

The integration of modern pharmacognostical tools with classical *Dravyaguna* principles offers a scientifically robust approach for herbal drug standardization^[3]. Advanced analytical techniques such as High Performance Thin Layer Chromatography (HPTLC), Gas Chromatography–Mass Spectrometry (GC-MS), microscopic imaging, histochemical analysis, and molecular authentication methods can provide

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reproducible diagnostic markers for medicinal plants^[3,4]. These tools not only help in distinguishing genuine drugs from adulterants but also facilitate global acceptance of Ayurvedic medicines through scientifically validated quality control parameters^[1,4]. Incorporating such modern analytical approaches is therefore indispensable for preserving the authenticity, safety, and clinical efficacy of traditional medicinal plants like *Mamajjaka*.

Enicostema axillare (Lam.) A. Raynal, known as *Mamajjaka* or *Mamejavo*, belonging to Gentianaceae family is a house hold remedy of Gujarat, particularly within the Sourashtra region^[4,5]. As per Ayurvedic principles, it is predominant of *Tikta Rasa* (bitter taste), with *Kaphapitta shamana karma* and a potent *Vishama jwaraghna dravya*^[6].

India possesses one of the richest ethnomedicinal plant traditions in the world, with diverse tribal and regional healthcare practices distributed across different ecological zones. From the Western Ghats and Himalayan belt to arid and coastal regions, numerous medicinal plants continue to be used in local healing traditions but remain scientifically underexplored. Much of this traditional knowledge is transmitted orally and faces the threat of gradual disappearance due to urbanization, habitat loss, and commercial exploitation. Hence, there is an urgent need to systematically document, validate, and scientifically investigate the ethnomedicinal plant wealth of the country using interdisciplinary research approaches. Such efforts will not only strengthen evidence-based Ayurveda but also contribute toward biodiversity conservation, drug discovery, and protection of indigenous medical knowledge systems

While traditionally indicated for *Madhumeha* (diabetes mellitus) and *Yakrut-Vikara* (liver disorders), the rising global demand for herbal medicine has led to its adulteration with other members of the Gentianaceae family. Standardizing this plant is necessary to identify the botanical source as well as to achieve success of treatment to preserve the integrity of Ayurvedic therapeutics.

AIMS

1. To establish a comprehensive bridge between Ayurvedic profile of *Mamajjaka* and Modern Pharmacognostic Data, ensuring its Botanical Identity, Therapeutic efficacy and Global

Standardization of this Ethnomedicinal Plant of Gujarat.

2. To highlight important macroscopic and microscopic markers for authenticating *Enicostema axillare*, from its adulterants.
3. To emphasise the need for a Digital Repository of Gujarat's Ethnomedicine to protect the intellectual property and clinical integrity of local Ayurveda practices.

This study adopts a systematic review and integrative synthesis of existing pharmacognostical and phytochemical data regarding *Enicostema axillare*. The methodology involves different steps to bridge Ayurveda principles with modern analytical methods.

Literary Review

A comprehensive search was conducted across different Classical Ayurveda Text Books and Modern Scientific Data bases to gather information on *Mamajjaka/Enicostema axillare*. Classical Ayurveda books like Shodhala Nighantu, Bhavaprakasha Nighantu, Priya Nighantu etc. were referred for Ayurvedic principles like *Rasapanchaka* and its *Guna-karma-prayoga*^[6,7,8]. Scientific data bases like PubMed, Google Scholar, ScienceDirect as well as AYUSH Research Portal were searched.

Inclusion and Exclusion Criteria: In order to ensure the reliability of the compiled data, the following Criteria were adopted.

Inclusion criteria: Studies with validated microscopic images, HPTLC chromatogram with clear Rf values are included.

Exclusion criteria: Studies with unauthenticated botanical source, data from non-peer reviewed articles were excluded from the study.

Synthesis and Integration of compiled Data: Compilation of Morphological – Anatomical features, for example: microscopic markers like stomatal index, phloem arrangement. Reviewing HPTLC and GC-MS data to specifically identify, most consistent marker of *Enicostema axillare*- Swertiamarin and its relation with *Tikta rasa*. Along with that, documented differences between *Mamajjaka* and its adulterants were evaluated to identify the genuine source for physicians. Through the systematic review of authenticated pharmacognostic literature, the following “Diagnostic Markers” have been identified as the gold standard for verifying *Mamajjaka* (E. axillare).

Table 1: Diagnostic Differentiation Profile for Authenticating *Encostema axillare* (Mamajjaka)

Diagnostic features	Genuine <i>Encostema axillare</i> (Mamajjaka)	Common Gentianaceae Adulterants/Substitutes	Quality Control & Therapeutic Significance
Macroscopic	- Quadrangular stem featuring four distinct longitudinal wings^[4]. - Persistently intense bitter taste (<i>Tikta Rasa</i>)	- Cylindrical or weakly ribbed stems. - Variable bitterness, often milder or lingering differently.	Prevents bulk substitution of raw whole-plant materials in commercial trading hubs.
Microscopic (Stem)	Intra-xylary phloem consistently present (located on the inner side of the xylem adjacent to the pith) ^[4,9] .	Inter-xylary phloem or standard collateral vascular bundle arrangements.	Primary anatomical marker. Confirms correct botanical source even when the plant is coarsely crushed.
Microscopic (Leaf)	- Anisocytic stomata (stoma guarded by three subsidiary cells, with one distinctly smaller).^[4,10] - Quantitative Stomatal Index: 18–22.	- Anomocytic or paracytic stomatal configurations. - Divergent stomatal index ranges.	Powder microscopy standard. Crucial for verifying identity when the natural morphology is lost in powder blends.
Phytochemical Fingerprint	Highly stable presence of the secoiridoid glycoside Swertiamarin ^[11] . Prominent HPTLC band at Rf 0.48 – 0.55 under UV 254 nm ^[12] .	Trace amounts or complete absence of Swertiamarin; distinct alternative glycoside bands.	Bioactive validation. Ensures the sample contains the molecules responsible for the insulin-mimetic action.
Volatile Profile	Distinctive presence of the alkaloid Gentianine along with characteristic phytosterols ^[11] .	Differing alkaloid matrix lacking the specific <i>Mamejava</i> volatile signature.	Validates the authentic secondary metabolic activity and aroma profile of the regional ethnomedicine.

Macroscopic Diagnostic Markers

The compilation of anatomical data reveals two internal structures that remain consistent across authenticated samples: Review of stem transverse sections consistently shows phloem bundles located on the inner side of the xylem (adjacent to the pith)-intraxylary phloem^[4,9]. The stem typically features a single -layered epidermis followed by a cortex containing chlorenchyma cells, which contribute to its pharmacological properties^[4]. This is a peculiar botanical character in the Gentianaceae family. Leaf microscopy reveals *Anisocytic stomata*^[4,10] (where the stoma is surrounded by three subsidiary cells, one being significantly smaller). Compiled data suggests a specific Stomatal Index (18–22), which provides a quantitative metric for leaf-powder authentication.

Phytochemical Fingerprinting

The phytochemical profile of *Mamajjaka* is defined by its secoiridoid glycosides, which represent the molecular essence of its *Tikta Rasa*. Across all reviewed chromatographic studies, Swertiamarin, emerges as the most stable and prominent bioactive marker^[11]. Under UV 254nm, a sharp, high-intensity

band is observed at Rf 0.48 – 0.55 ^[12] (depending on the mobile phase). This compound is confirmed to be the primary driver behind the plant's insulin-mimetic and hepatoprotective properties^[5,13]. Analysis of the volatile constituents in GC-MS Profile reveals a complex matrix of alkaloids (Gentianine) and sterols. This "Volatile Fingerprint" is what provides the characteristic aroma and secondary metabolic actions of the fresh *Mamejava* plant used in Gujarat's folk medicine.

DISCUSSION

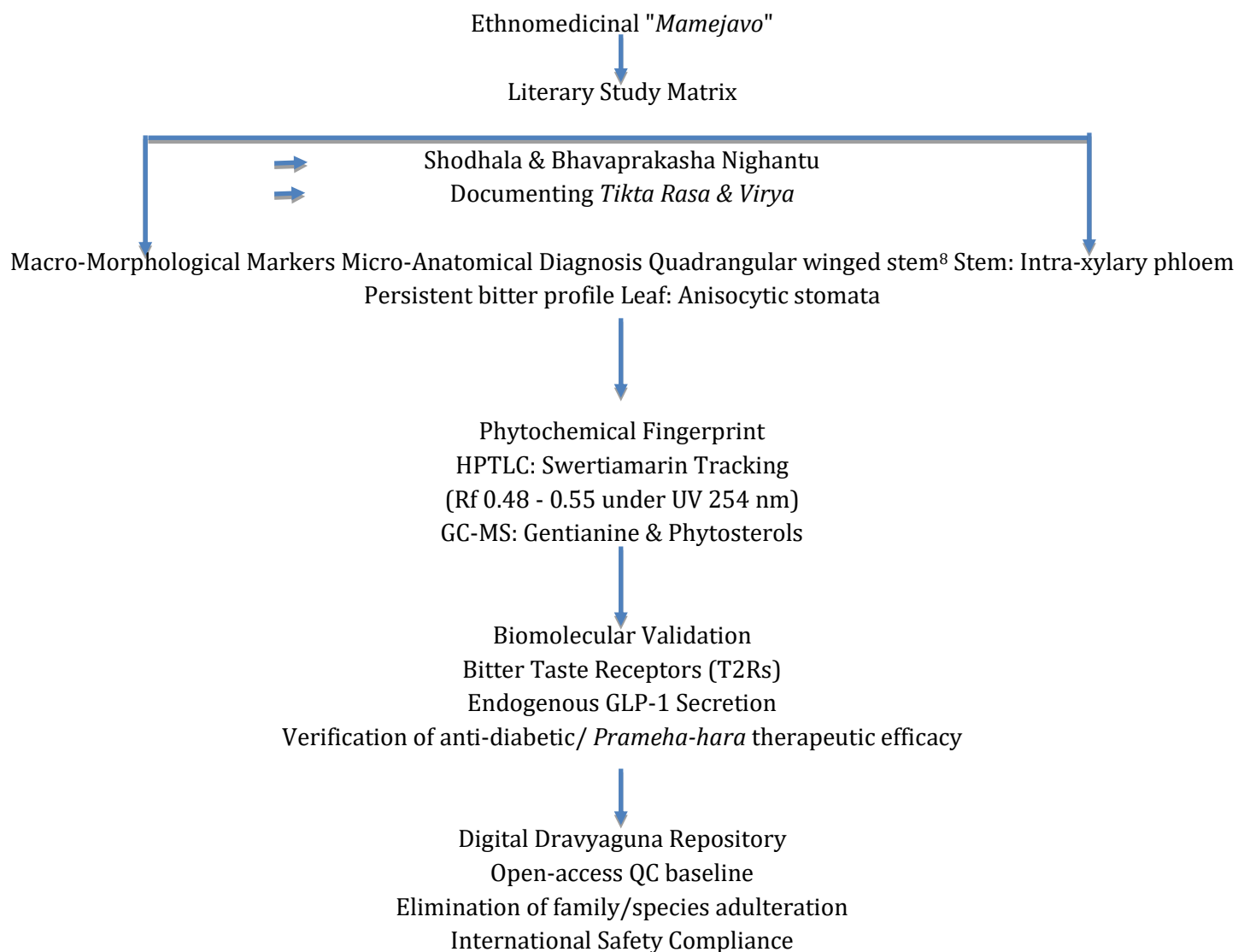
The results of this compilation suggest that the "*Tikta-Virya*" of *Mamajjaka* described in *Shodhala Nighantu* is not a subjective observation but it can be a chemically verifiable reality. If a commercial sample of "*Mamejava*" lacks these two markers- Intra-xylary phloem and Swertiamarin, its *Prameha-hara* (anti-diabetic) efficacy is compromised. The link between Swertiamarin and glucose metabolism validates the Deepana (digestive stimulant) property, as modern science shows these bitters trigger the release of

gastric hormones (GLP-1) which improve insulin response.

The intense bitterness of *Mamajjaka* may be directly attributed to secoiridoid glycosides such as Swertiamarin and Gentianine. Modern studies suggest bitter phytoconstituents interact with bitter taste receptors (T2Rs), influencing metabolic signaling pathways including GLP-1 secretion [14,15], insulin sensitization, and hepatic enzyme modulation. This establishes a possible molecular basis for Ayurvedic Crude Plant Identification

concepts like *Deepana*, *Pachana*, and *Prameha-hara karma*.

Schematic diagram illustrating the step-by-step integrated evaluation process for *Enicostema axillare*. The blueprint shows the operational workflow starting from raw ethnomedicinal collection, passing through dual macroscopic and microscopic analytical gates, validating bioactive molecular pathways, and culminating in the establishment of a standardized Digital *Dravyaguna* Repository entry.



Adulteration and substitution not only reduce potency but may also alter pharmacodynamics and safety profiles. In Ayurvedic clinical practice, therapeutic failure may occur not because of formulation inadequacy, but because of incorrect botanical identity. Standardization therefore becomes clinically relevant, not merely academic.

Traditionally, a *Vaidya* identified a plant by its Morphology. In the modern era of powdered extracts and global trade, we must adopt other advanced ways to authenticate the drug. The HPTLC fingerprint is

effectively a "Digital Nighantu" entry that ensures the efficacy of classical formulations. The proposed Digital Dravyaguna Repository for Gujarat's local flora would serve as an open-access authentication tool. This would mitigate the risks of commercial adulteration and ensure that the "*Mamejava*" / "*Chhota chirayata*"^[8], used in clinical practice meets international safety and toxicity standards.

CONCLUSION

Gujarat folk medicine traditions represent valuable undocumented therapeutic knowledge. Ethnomedicinal practices often preserve region-specific therapeutic indications unavailable in classical texts. Digitization and scientific validation can protect traditional intellectual heritage from biopiracy and knowledge erosion.

Standardizing *Mamajjaka* is a vital step toward the global validation of Ayurveda. With the integration of traditional knowledge and high-tech analytical tools, we can ensure the efficacy of *Mamajjaka*. The present integrative approach demonstrates that traditional Ayurvedic drug identification principles can be scientifically strengthened through modern pharmacognostical and phytochemical technologies, thereby creating a reproducible framework for global acceptance of ethnomedicinal plants.

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