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REVIEW OF *SWERTIA CHIRAYITA* AND PROBLEMS ASSOCIATED WITH ITS ADULTERATION

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ABSTRACT

Background: *Swertia chirayita* (Chirayata) is a well-known medicinal plant used in Ayurveda and other traditional systems for the management of fever, liver disorders, digestive disturbances, and metabolic diseases. It possesses strong *Tikta Rasa* and acts through *Deepana* and *Pachana* properties. Due to its wide therapeutic utility and high demand, the plant has become critically endangered and is frequently subjected to adulteration and substitution in the crude drug market. **AIM** To critically review the medicinal importance of Swertia chirayita and to analyze the problems associated with its adulteration in the crude drug market. **Objectives** To study the classical Ayurvedic properties of Swertia chirayita including Rasa, Guna, Virya, and Vipaka. To compile and analyze modern scientific data related to the phytochemical constituents and pharmacological activities of Swertia chirayita. To identify commonly used adulterants and substitutes of Swertia chirayita in the herbal drug market. To evaluate the impact of adulteration on therapeutic efficacy, safety, and quality of herbal formulations. To highlight challenges in standardization, authentication, and quality control of Swertia chirayita. To emphasize the need for conservation and sustainable utilization of Swertia chirayita. **Materials and Methods:** This is a narrative review based on

classical Ayurvedic texts and modern scientific literature, including pharmacological and phytochemical studies. Relevant information was collected from research articles, review papers, and pharmacopeial sources focusing on medicinal uses, active constituents, and adulteration issues. **Results:** *Swertia chirayita* contains important bioactive compounds such as amarogentin, swertiamarin, and mangiferin, which contribute to its antidiabetic, hepatoprotective, anti-inflammatory, and antimicrobial activities. However, due to scarcity and high market demand, it is often adulterated with species like *Andrographis paniculata* and other *Swertia* species. These substitutes differ in pharmacological properties and may alter therapeutic outcomes. Adulteration leads to reduced efficacy, compromised safety, and difficulty in standardization of herbal formulations. **Conclusion:** *Swertia chirayita* is a valuable medicinal plant with significant therapeutic potential, but adulteration remains a major challenge affecting its authenticity and clinical effectiveness. There is a need for strict quality control measures, proper identification techniques, and conservation strategies to ensure its sustainable use and therapeutic reliability.

Keywords: *Swertia chirayita*, Adulteration, Phytochemistry, Pharmacological activity, Medicinal plant, Quality control

INTRODUCTION

Swertia chirayita is an important medicinal plant widely used in Ayurveda and other traditional systems of medicine for its diverse therapeutic properties. It is commonly known as Chirayata and is characterized by its intense bitterness due to the presence of active constituents like amarogentin. In Ayurveda, it is considered rich in *Tikta Rasa* and is mainly used for correcting *Agnimandya*[1] and managing disorders related to *Pitta* and *Kapha Dosha*. Traditionally, it has been employed in conditions like *Jwara*,[2] *Yakrit Vikara*,[3] *Kustha*,[4] and *Madhumeha*,[5] highlighting its broad clinical utility.

The plant is distributed mainly in the Himalayan region and grows in temperate climates at higher altitudes. Despite its medicinal importance, *Swertia chirayita* has been classified as a critically endangered species due to excessive harvesting from natural habitats and increasing commercial demand. The whole plant is used therapeutically, though the root is considered more potent. Its declining availability has created a gap between demand and supply, which has led to various challenges in its sustainable utilization.

From a pharmacological perspective, *Swertia chirayita* has shown a wide range of biological activities such as antidiabetic, hepatoprotective, anti-inflammatory, antimicrobial, and antioxidant effects. These actions are mainly attributed to its phytoconstituents like xanthones, flavonoids, alkaloids, and secoiridoid glycosides. Modern studies have validated many of its traditional uses, making it an important subject of research in both herbal medicine and pharmacology.

However, one of the major issues associated with *Swertia chirayita* is its adulteration and substitution in the crude drug market. Due to its scarcity and high demand, it is often replaced with other species like *Andrographis paniculata* and related plants, which may not possess the same therapeutic efficacy. This adulteration leads to reduced clinical effectiveness, variability in drug quality, and challenges in standardization. Therefore, understanding the authenticity, proper identification, and quality control of *Swertia chirayita* becomes essential for ensuring its safe and effective use.

MATERIAL AND METHODS

This study is a narrative review based on both classical Ayurvedic literature and modern scientific sources. Information related to *Swertia chirayita* was collected from Ayurvedic texts for its *Rasa*, *Guna*, *Virya*, and *Vipaka*, along with its therapeutic indications. Modern data were gathered from published research articles, review papers, pharmacopeias, and online scientific databases focusing on phytochemistry, pharmacological activities, and clinical relevance. Special emphasis was given to literature describing adulteration, substitution, and quality control issues of *Swertia chirayita*. The collected data were critically analyzed and compiled to understand its medicinal importance and the challenges associated with its authenticity and standardization.

Swertia chirayita (*Kiratatikta* / Chirayata)

Swertia chirayita[6] is a well-known bitter medicinal herb of the family Gentianaceae and is widely used in Ayurveda, *Unani*, *Siddha*, and folk medicine. It is especially valued for its intense *Tikta Rasa*,[7] cooling nature, and usefulness in conditions like *Jwara*, *Daha*, *Kustha*, *Krimi*, *Meha*, and disorders associated with impaired digestion and altered *Pitta-Kapha*.[8] The Ayurvedic Pharmacopoeia of India identifies the official drug as the whole plant of *Swertia chirata* Buch.-Ham. collected during flowering and dried. It is described as a small erect annual herb found in the temperate Himalayas from Kashmir to Bhutan and in the Khasi hills of Meghalaya.

Taxonomical[9] Classification

Category	**Classification**
Kingdom	Plantae
Division	Angiosperms
Class	Dicotyledons
Order	Gentianales
Family	Gentianaceae
Genus	*Swertia*
Species	*Swertia chirayita* / *Swertia chirata*

This taxonomic placement is consistent with the uploaded reviews and the API monograph.

Vernacular[10] Names

Language	**Name**
Sanskrit	*Kirata*, *Kirataka*, *Bhunimba*, *Kiratatiktaka*
Assamese	Chirta
Bengali	Chirata
English	Chireta
Gujarati	Kariyatu, Kariyatun
Hindi	Chirayata
Kannada	Nalebevu, Chirata Kaddi, Chirayat
Kashmiri	Lose, Chiraita
Malayalam	Nelaveppu, Kirayathu, Nilamakanjiram
Marathi	Kiraita, Kaduchiraita
Oriya	Chireita
Punjabi	Chiretta, Chiraita
Tamil	Nilavembu
Telugu	Nelavemu
Urdu	Chiraita

Synonyms[11] in Different Acharyas

Source tradition	Synonyms used
Classical Ayurvedic usage	*Kiratatikta*
Nighantu usage	*Kirata*
Nighantu usage	*Kirataka*
Nighantu usage	*Bhunimba*
API compiled classical synonym set	*Kirata*, *Kirataka*, *Bhunimba*, *Kiratatiktaka*

***Rasa Panchaka*[12]**

Parameter	Description
Rasa	*Tikta*
Guna	*Laghu*, *Ruksha*
Virya	*Shita*
Vipaka	*Katu*
Prabhava	Not separately stated in API; clinically inferred from marked *Jvaraghna*, *Raktashodhaka*, and *Trishnapaha* action

Karma[13] (Therapeutic Actions)

Action	Status
Jvaraghna	Directly stated
Kaphapittahara	Directly stated
Raktashodhaka	Directly stated
Vranashodhana	Directly stated
Saraka	Directly stated
Trishnapaha	Directly stated

Botanical[14] Description

Habit

Swertia chirayita is a small, erect, annual or sometimes described as annual-biennial herbaceous plant. The API monograph describes it as an erect annual herb about 0.6 to 1.25 m high. The uploaded review also notes that different authors have described it as annual, biennial, or pluriannual, but all agree that it is a tall bitter herb of the Himalayan belt.

Habitat

It grows in the temperate Himalayas at about 1200 to 3000 m altitude, from Kashmir to Bhutan, and also in the Khasi hills of Meghalaya. The review article similarly describes distribution in sub-temperate Himalayan regions, especially moist shady slopes and forest openings.

Morphological Characters[15]

The plant has an erect glabrous stem, cylindrical below and slightly quadrangular above, opposite leaves, paniculate branching, small tetramerous flowers, and a capsule containing minute reticulated seeds. The stem is yellowish-brown to purplish with a large yellow pith. Leaves are ovate to lanceolate, entire, sessile, acuminate, and usually show 5 to 7 prominent lateral veins. Flowers bear two glandular depressions near the base of each corolla lobe. The fruit is a capsule with numerous minute seeds.

Macroscopy[16]

The crude drug consists of the whole plant. A fresh sample shows a peculiar shining yellowish tinge all over the herb. The stem is up to 1 m long and about 6 mm in diameter. Leaves are opposite and cauline. Flowers are small, about 2 to 3 mm wide, ovoid, and tetramerous. Seeds are minute, irregularly ovoid, and reticulated. These are official macroscopic characters in API and are useful for raw drug identification.

Microscopy[17]

The root transverse section shows 2 to 4 layers of cork, secondary cortex made of thick-walled parenchymatous cells, secondary phloem, and lignified secondary xylem with vessels, tracheids, and xylem fibres. Minute acicular crystals and resin masses are present, and older

roots may become spongy and hollow centrally. The stem shows a single layered epidermis, cortical cells, distinct endodermis, single layered pericycle, amphiphloic siphonostele, and a central pith with intercellular spaces. The leaf shows anisocytic stomata, single layered palisade, 4 to 7 layered spongy mesophyll, mucilage, acicular crystals, and oil droplets.

Phytochemical[18] Constituents (Chemical Composition)

The uploaded review identifies a broad phytochemical profile for *Swertia chirayita*. Major groups include xanthones and xanthone glycosides, flavonoids, iridoids and secoiridoids, alkaloids, lignans, terpenoids, tannins, phenols, triterpenes, and related compounds. Key named constituents repeatedly mentioned are amarogentin, swertiamarin, mangiferin, swerchirin, sweroside, amaroswerin, and gentiopicrin. The API monograph specifically lists xanthones, xanthone glycoside, and mangiferin among official constituents.

Alkaloids

Alkaloids are reported in phytochemical studies and are included among the detected secondary metabolites in the 2022 review, although the API monograph does not emphasize alkaloids as the principal standardizing marker.

Glycosides

Secoiridoid glycosides are among the most important constituents, especially amarogentin and swertiamarin. Amarogentin is highlighted as an extremely bitter principle and a major marker compound.

Flavonoids

Mangiferin is the best-known flavonoid associated with *Swertia chirayita*, and the API monograph specifically mentions mangiferin. Other flavonoid fractions are described in phytochemical studies summarized in the uploaded reviews.

Tannins

General phytochemical screening in the uploaded 2022 review reports tannins in crude extracts, but the official API monograph includes a simple test noting absence of tannin by ferric chloride color reaction in the official drug sample standard. This is important because

screening reports and official raw drug specification are not always identical in wording or method.

Saponins

Saponins are reported in phytochemical screening studies summarized in the 2022 review.

Steroids

Phytochemical work summarized in the 2022 review reports sterols and related phytosterol fractions in some extracts.

Phenolic Compounds

Phenolics are repeatedly reported in phytochemical screening and contribute to antioxidant potential.

Volatile Oils

The API monograph for *Kiratatikta* does not list volatile oil as a principal official constituent or standardization parameter. So it is better to state that volatile oil is not a major defining constituent in the official API profile for this drug.

Pharmacological[19] Activities

Anti-inflammatory

Experimental studies summarized in the 2016 review show anti-inflammatory activity from aerial parts and root extracts in animal models, with comparison to diclofenac in some studies. This supports the traditional use of the drug in inflammatory and febrile states.

Antioxidant

The 2016 review reports significant antioxidant activity in ethanolic, methanolic, aqueous, and leaf extracts using DPPH, ABTS, FRAP, and beta-carotene systems. Reported values vary by solvent and plant part, but the overall evidence supports antioxidant potential.

Antimicrobial

The uploaded review documents antibacterial activity against organisms such as *Escherichia coli*, *Staphylococcus aureus*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, and others, along with antifungal activity against *Aspergillus* and *Cladosporium* species.

Immunomodulatory

Direct immunomodulatory evidence is not emphasized strongly in the uploaded reviews. However, the plant's antioxidant, anti-inflammatory, antimicrobial, and adaptogenic style actions suggest immune-supportive relevance. This should be presented cautiously as supportive rather than strongly established.

Hepatoprotective

Traditional use in liver disorders is strongly echoed by modern studies. The reviews note hepatoprotective activity and mention use in hepatitis and related liver dysfunction, including anti-hepatitis B virus activity in cell line studies.

Neuroprotective

The 2022 review mentions antiparkinsonian activity of methanolic extract in haloperidol-induced catalepsy in rats. Older literature also reports central nervous system activity associated with swertiamarin and the whole plant. That makes neuroprotective potential promising, though still not as strongly established as antidiabetic or hepatoprotective action.

Antidiabetic

Both reviews identify antidiabetic and hypoglycemic activity. The 2016 review lists whole plant and leaf extracts showing hypoglycemic effects in vivo, and the phytochemical discussion links this action especially with amarogentin, swertiamarin, mangiferin, and swerchirin.

Adaptogenic

A direct modern adaptogenic model is not strongly detailed in the uploaded papers, but traditional use as a bitter tonic and anti-fatigue support is mentioned. So this heading is better written as emerging or probable rather than conclusively established.

Anticancer

The reviews mention anticarcinogenic and anticancer activity, including cytotoxic and anti-tumor findings associated with xanthones and amarogentin. These findings are promising but largely preclinical.

Therapeutic Indications

API therapeutic uses include *Shotha*, *Daha*, *Jwara*, *Krimiroga*, *Kandu*, *Kustha*, *Meha*, *Trishna*, and *Vrana*. The review papers further expand its traditional use to liver disorders, digestive disorders, malaria, anemia, asthma, ulcers, skin diseases, and diabetes.

Dosage[20]

Preparation form	Dose
Powder	1 to 3 g
Decoction drug quantity	20 to 30 g

Anupana[21]

The API monograph does not separately specify *Anupana* in the lines available here. In practice, *Kiratatikta* is commonly administered with water, decoction base, or suitable vehicle according to condition and formulation. This point should ideally follow the formulation-specific context rather than a single universal *Anupana* claim.

Adverse Effects[22]

The 2016 review states that despite long traditional use, there is still inadequate scientific safety evaluation and more rigorous toxicological and clinical study is needed. Available animal and limited clinical observations described there did not show obvious toxicity, but the evidence is still not strong enough to declare complete safety under all conditions. So the most accurate statement is that no major toxicity is clearly established in the available reviewed literature, yet formal safety data remain insufficient.

Classical Formulations

Formulation	Status
Sudarshana Churna[23]	Listed in API monograph
Chinnodbhavadi Kvatha Churna[24]	Listed in API monograph

Standardization as per API (Ayurvedic Pharmacopoeia)

API Standardization[25]

Parameter	**Standard**
Official drug	Whole plant of *Swertia chirata* Buch.-Ham.
Foreign matter	Not more than 2%
Total ash	Not more than 6%
Acid-insoluble ash	Not more than 1%
Alcohol-soluble extractive	Not less than 10%
Water-soluble extractive	Not less than 10%
Tannin test	Absent by ferric chloride test
Assay	Not less than 1.3% bitter principle

PROBLEMS ASSOCIATED WITH ADULTERATION OF *SWERTIA CHIRAYITA*

S. No.	**Problem**	**Explanation**
1	Use of substitutes	Replacement with plants like *Andrographis paniculata* and other *Swertia* species due to scarcity and high demand
2	Loss of therapeutic efficacy	Absence or low concentration of key compounds like amarogentin leads to reduced clinical effectiveness
3	Variation in pharmacological action	Different substitutes have different *Virya* and *Karma*, altering expected *Dosha* balance and treatment outcome
4	Safety concerns	Adulterants may contain unknown or untested phytochemicals leading to possible toxicity or adverse effects
5	Difficulty in standardization	Mixed or incorrect raw material causes inconsistency in phytochemical profile and drug quality
6	Impact on research	Use of adulterated samples leads to unreliable experimental and clinical results

7	Economic issues	Decreases market trust and reduces value of genuine *Swertia chirayita*
8	Conservation pressure	Overharvesting and scarcity promote adulteration, further threatening the species
9	Poor quality control	Lack of proper authentication methods allows adulterated drugs to enter the market
10	Clinical unpredictability	Variability in drug composition results in inconsistent therapeutic responses

RESULT AND FINDINGS

- *Swertia chirayita* is confirmed as a potent medicinal plant with dominant *Tikta Rasa* and significant role in correcting *Agnimandya* and *Pitta-Kapha* disorders.
- The plant contains important bioactive compounds such as amarogentin, swertiamarin, mangiferin, and swerchirin, which are responsible for its therapeutic actions.
- Modern studies validate its pharmacological activities including anti-inflammatory, antioxidant, antimicrobial, hepatoprotective, and antidiabetic effects.
- The drug shows strong clinical relevance in conditions like *Jwara*, *Yakrit Vikara*, *Madhumeha*, *Kustha*, and digestive disorders.
- Review findings indicate that *Swertia chirayita* is critically endangered due to overharvesting, habitat loss, and increasing commercial demand.
- Adulteration is identified as a major issue, with common substitution by plants like *Andrographis paniculata* and other *Swertia* species.
- Adulteration leads to significant reduction in therapeutic efficacy due to variation or absence of key phytoconstituents.
- Differences in *Virya* and pharmacological properties between genuine drug and substitutes result in altered or unpredictable clinical outcomes.
- Lack of proper standardization and authentication methods contributes to poor quality control in the herbal drug market.
- Adulteration also affects research reliability, leading to inconsistent and non-reproducible scientific results.

- Safety concerns arise due to the use of unverified substitutes, which may have unknown toxicity profiles.
- The combined effect of adulteration and overexploitation creates challenges in ensuring availability of authentic and effective *Swertia chirayita*.

DISCUSSION

The present review highlights that *Swertia chirayita* is a highly significant medicinal plant with strong therapeutic potential described in both classical Ayurveda and modern pharmacology. Its properties such as *Tikta Rasa*, *Laghu-Ruksha Guna*, and *Sheeta Virya* make it especially effective in managing *Pitta-Kapha* dominant disorders like *Jwara*, *Yakrit Vikara*, and *Madhumeha*. The presence of bioactive compounds like amarogentin, swertiamarin, and mangiferin further supports its wide range of pharmacological actions including anti-inflammatory, hepatoprotective, antioxidant, and antidiabetic effects. Thus, there is a clear correlation between classical Ayurvedic concepts and modern scientific validation, confirming its importance as a valuable therapeutic agent.[26]

However, despite its proven efficacy, the major concern identified in this review is the widespread adulteration and substitution of *Swertia chirayita* in the crude drug market. Due to its limited availability and increasing demand, it is often replaced with other bitter plants like *Andrographis paniculata* or related species, which do not possess identical pharmacological properties. This leads to significant variation in therapeutic outcomes, reduced efficacy, and potential safety risks. Moreover, adulteration creates serious challenges in standardization, quality control, and pharmaceutical processing, ultimately affecting the reliability of Ayurvedic formulations and clinical practice.[27]

Another important issue is the conservation status of *Swertia chirayita*, which has been categorized as critically endangered due to overexploitation and habitat destruction. The scarcity of genuine raw material not only promotes adulteration but also threatens the sustainability of its therapeutic use. Therefore, there is an urgent need for proper identification techniques, strict quality control measures, and implementation of conservation strategies such as cultivation and tissue culture. Integrating classical knowledge with modern scientific approaches can help ensure the authenticity, safety, and long-term availability of *Swertia chirayita* for effective clinical use.[28]

CONCLUSION

Swertia chirayita is a highly valuable medicinal plant with well-established importance in Ayurveda due to its *Tikta Rasa*, *Deepana-Pachana* action, and effectiveness in managing *Pitta-Kapha* disorders such as *Jwara*, *Yakrit Vikara*, and *Madhumeha*. Modern scientific studies also support its diverse pharmacological activities, including anti-inflammatory, hepatoprotective, antioxidant, and antidiabetic effects. However, its therapeutic potential is significantly compromised by widespread adulteration, lack of proper standardization, and declining natural availability due to overexploitation. These challenges not only reduce drug efficacy and safety but also affect clinical reliability and research outcomes. Therefore, strict quality control, proper authentication, and sustainable conservation practices are essential to preserve the authenticity and ensure the effective use of *Swertia chirayita* in both traditional and modern medicine.

CONFLCIT OF INTEREST -NIL

SOURCE OF SUPPORT -NONE

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