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# An Integrative Review of Ayurvedic Significance and Biomedical Potential of *Tecomella undulata* (Sm.) Seem. (*Rohitaka*)

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**ABSTRACT :**

*Tecomella undulata* (Sm.) Seem., commonly known as *Rohitaka*, is a deciduous tree of the family Bignoniaceae, predominantly distributed in the arid and semi-arid regions of India. It is considered an economically valuable timber plant as well as a highly revered medicinal species. In Ayurveda, *Rohitaka* is described as an effective remedy for *yakrit vikara* (liver disorders), *pandu* (anemia), *krimi* (helminthiasis), *kushta* (skin diseases), and *shotha* (inflammatory conditions). Classical Ayurvedic formulations such as *Rohitakarishta* and *Rohitakadi churna* have incorporated this plant for centuries in the treatment of hepatic and splenic enlargements.

Phytochemical investigations reveal the presence of diverse bioactive compounds including flavonoids (quercetin, luteolin), terpenoids (ursolic acid, betulinic acid), alkaloids (tecomine), and phenolic glycosides, which contribute to its broad spectrum of pharmacological activities. Modern pharmacological studies have reported its hepatoprotective, anti-inflammatory, antioxidant, antimicrobial, and anticancer potential. The bark extracts have demonstrated significant efficacy against $CCl_4$-induced hepatotoxicity in experimental models, while antioxidant activity is attributed to the high polyphenolic content. Furthermore, preliminary cytotoxic studies indicate its potential role in cancer therapy.

Despite promising ethnomedicinal claims and experimental evidence, systematic clinical validation and mechanistic studies on *T. undulata* remain limited. Standardization of extracts, isolation of active phytoconstituents, and toxicological profiling are necessary to ensure its safe therapeutic application. This review provides a comprehensive account of its botany, phytochemistry, pharmacological activities, and Ayurvedic uses, while emphasizing existing research gaps and future prospects for its development as a standardized phytomedicine.

**Keywords**: *Rohitaka, Tecomella undulata,* Bignoniaceae, Desert Teak

## Introduction

The family Bignoniaceae, commonly known as the trumpet creeper family, comprises nearly 100 genera and more than 850 species distributed mainly in tropical and subtropical regions of the world. Plants of this family are well known for their ornamental value, timber utility, and medicinal importance. Several members have been traditionally used in indigenous systems of medicine due to the presence of diverse phytoconstituents such as flavonoids, terpenoids, and alkaloids **[1]**.

Within this family, *Tecomella undulata* (Sm.) Seem., commonly known as *Rohitaka*, Desert Teak, or Sandan, holds significant ethnomedicinal and pharmacological importance. It is a deciduous shrub or small tree, usually growing up to 2–3 meters in height, characterized by simple opposite leaves with undulate margins and bright orange to yellowish flowers, which impart high ornamental value. The plant thrives in arid and semi-arid regions, being predominantly distributed in the western parts of India, including Rajasthan, Punjab, Gujarat, and Madhya Pradesh, and also occurs in parts of Pakistan **[2]**.

In Ayurveda, *Tecomella undulata* is well identified with *Rohitaka*, a classical drug described in all the Brhat Trayi texts (*Charaka, Sushruta,* and *Ashtanga Hridaya*). It is traditionally prescribed in the treatment of yakrit vikara (liver disorders), *pandu* (anemia), *krimi* (helminthiasis), *kushta* (skin diseases), and *shotha* (inflammatory conditions). The identity of *Rohitaka* is clearly indicated in its rural and descriptive names applicable to *Tecomella*. *Caraka* described *Rohitakī latā* with synonyms such as *'Rohera'* and *'Dadimacchada'*, which are undoubtedly attributed to *Tecomella*. Such terminological and morphological correlations strongly validate *T. undulata* as the genuine source of *Rohitaka* **[3].**

Phytochemically, the plant is reported to contain flavonoids (quercetin, luteolin), terpenoids (ursolic acid, betulinic acid), alkaloids (tecomine), phenolic compounds, and glycosides. These compounds are largely responsible for its hepatoprotective, antioxidant, antimicrobial, anti-inflammatory, and anticancer effects, which corroborate its traditional use in liver and skin disorders **[4]**.

Given its ecological uniqueness, Ayurvedic significance, and emerging pharmacological evidence, *Tecomella undulata* stands as a promising medicinal species. However, despite centuries of traditional usage, systematic clinical studies, standardization, and toxicological evaluations remain limited, necessitating further exploration to establish its therapeutic potential on a global platform.

## Categorization As Per Classical Text [5,6,7,8]

| S. No. | Text | Varga |
|---|---|---|
| 1. | Bhava prakasha Nighantu | Vatadi varga |
| 2. | Dhanvantari Nighantu | Amradi varga |
| 3. | Kaiyyadeva Nighantu | Aushadhi varga |
| 4. | Raja Nighantu | Shalmalyadi varga |

**Scientific classification [9]**

| Taxonomic Rank | Name |
|---|---|
| Kingdom | Plantae |
| Phylum | Streptophyta |
| Class | Equisetopsida |
| Subclass | Magnoliidae |
| Order | Lamiales |
| Family | Bignoniaceae |
| Genus | Tecomella |
| Species | *Tecomella undulata* |

**Vernacular Names [10]**

- Hindi name – Rugtrora / Rudanti
- English name – Desert teak
- Gujarati name – Rohido
- Kannada name – Mullumuntala
- Marathi name – Rohido
- Malayalam name – Cemmaram
- Punjabi name – Laberra
- Tamil name – Malampuluvan

**Sanskrit Synonyms of *Rohitaka* [5-8]**

- *Dadima pushpa, Dadimaschada* – Flowers resemble to that of pomegranate flower
- *Lohita, Rohita, Raktapushpa* – Flowers are red like blood
- *Kushalmali*, *Kuta shalmali* – Inferior variety of *shalmali* plant
- *Plihagna* – Helps to treat disease of the spleen
- *Raktaghna* – Useful in blood vitiation disorders
- *Yaktvairi* – Useful in splenomegaly
- *Varatikta* – One of the best *tikta dravya*

**Botanical Synonyms [11]**

- *Bignonia glauca Decne.*
- *Bignonia tropaeolum Jacquem. ex DC.*
- *Bignonia undulata Sm.*
- *Gelseminum undulatum (Sm.) Kuntze*
- *Tecoma glauca DC.*
- *Tecoma undulata (Sm.) G.Don*

**Botanical Description [4,11,12]**

- Plant type: Deciduous tree or large shrub, up to 2–6 m tall.
- Stem / Bark: Bark is rough, grayish-brown, with longitudinal fissures; inner bark reddish.
- Leaves: Compound, pinnate, opposite; leaflets 5–7, ovate to lanceolate, glabrous, with entire margins.
- Flowers: Large, showy, funnel-shaped, orange to red in color; arranged in terminal or axillary panicles; resemble pomegranate flowers.
- Calyx: Cup-shaped, campanulate, 5-lobed.
- Corolla: Tubular, 5-lobed, bright orange-red.
- Fruit: Oblong, woody capsule, brown, containing numerous winged seeds.
- Seeds: Flat, winged, aiding wind dispersal.
- Flowering season: March to June.
- Fruiting season: July to September.
- Habitat / Distribution: Grows mainly in arid and semi-arid regions of Western India (Rajasthan, Gujarat, Maharashtra), often in sandy soils.

**Figure 1. *T. undulata* Tree**

**Figure 2. *T. undulata* Flowers**

**Figure 3. *T. undulata* Seeds**

**Rasa panchaka of Rohitaka [13]**

- Rasa (Taste) – Katu (Pungent), Tikta (Bitter), Kashaya (Astringent)
- Guna (Qualities) – Laghu (Light for digestion), Ruksha (Dry in nature)
- Vipaka – Katu (Undergoes Pungent taste after digestion)
- Veerya (Potency) – Sheeta (Cold)
- Karma (Actions) – Kaphavpitta shamaka (reduces vitiated kapha and pitta dosha)
- Prabhava (Special action) – Pleehagna (Acts against the diseases of the spleen)

**Useful Parts, Dosage and Ayurvedic Formulations [13]**

- Useful Part: Bark, Seed
- Dosage: Powder- 1-3 gm, Decoction- 50-100 ml
- Ayurvedic Formulation – *Rohitakarisht, Maharohitaka ghrita, Rohitakadya curna, Pleehashardula rasa, Rohitakadi Vati, Rohitaka Lauha, Mahamrityunjya Loha.*

**Phytochemistry of *Tecomella undulata* [4,14,15,16,17,18]**

| **Compound Class** | **Examples** | **Plant Part /Extract Type** |
|---|---|---|
| Flavonoids | Quercetin, Kaempferol, Rutin | Leaves (Methanolic extract), Bark (Ethanolic extract) |
| Triterpenoids | Betulinic acid, Ursolic acid, Oleanolic acid | Bark (Ethanolic extract), Leaves (Methanolic extract) |
| Phenolic Compounds | Gallic acid, Ellagic acid, Caffeic acid | Leaves (Aqueous extract), Bark (Methanolic extract) |
| Sterols | β-Sitosterol, Stigmasterol | Seeds (Hexane extract), Bark (Ethanolic extract) |
| Alkaloids | Lapachol, Radermachol, α-lapachone, β-lapachone | Bark (Ethanolic extract), Roots (Methanolic extract) |
| Iridoid Glucosides | 6-O-veratryl catalposide | Bark (Methanolic extract) |
| Fatty Acids | Linoleic acid (53%), Lauric acid | Seeds (Hexane extract) |
| Lignans | Not specified | Not specified |
| Other Compounds | Tectol, Veratric acid, Dehydrotectol, Triacontanol | Roots (Butanol extract) |

**Traditional Uses of Tecomella undulata (Rohitaka)**

*Tecomella undulata* (Sm.) Seem., commonly known as *Rohitaka*, Desert Teak, or *Rohida*, is a widely recognized medicinal plant in traditional Indian medicine, particularly Ayurveda. The plant is mainly found in arid and semi-arid regions of western India, including Rajasthan, Gujarat, and parts of Madhya Pradesh. Various parts of the plant, such as the bark, leaves, seeds, and stem, have been extensively used across India for their therapeutic properties. The bark is traditionally employed for treating liver disorders (*yakrit vikara*), syphilis, gonorrhea, painful swellings, gout, urinary discharges, tumors, leukoderma, leucorrhoea, splenomegaly, and for promoting wound healing. The leaves are used for managing flatulence, anorexia, traumatic wounds, piles, worm infestations, hepatitis, and tumors. Seeds are applied for abscesses, while the stem finds use in urinary disorders and syphilis treatment. Apart from medicinal uses, the plant also holds ethnobotanical importance as a source of timber and dye in rural communities. Across India, *Tecomella undulata* continues to be valued for its broad-spectrum traditional applications, highlighting its significance in both healthcare and cultural practices **[4,10,18]**.

**Pharmacological Activities of *Tecomella undulata* [19,20,21,22,23,24]**

| Activity | Plant Part (Extract) | Mechanism / Effect | Key Findings |
|---|---|---|---|
| **Hepatoprotective** | Bark (Ethanolic extract) | Reduces liver inflammation, oxidative stress, improves insulin sensitivity in NASH mice | Protected liver, normalized enzymes |
| **Anticancer** | Stem bark (Methanolic extract) | Inhibits growth of cancer cells (K562, COLO-205, MDA-MB231, HepG2) | Dose-dependent cytotoxicity |
| **Antidiabetic** | Whole plant (Aqueous/Methanolic) | Lowers fasting blood glucose, improves glucose tolerance in STZ-induced diabetic rats | Reduced blood glucose levels |
| **Antioxidant** | Bark (Ethanolic extract) | Enhances antioxidant status, reduces oxidative stress markers | Increased SOD, CAT, GSH levels |
| **Anti-inflammatory** | Bark (Ethanolic extract) | Reduces pro-inflammatory cytokines (TNFα, IL-1β), modulates MAPK signaling | Decreased cytokine levels, reduced inflammation |
| **Antimicrobial** | Bark (Ethanolic extract) | Shows antibacterial activity against various bacterial strains | Effective against gram-positive & gram-negative bacteria |
| **Antiviral** | Leaves (Methanolic extract) | Contains compounds with potential anti-HIV activity | Inhibits viral replication in vitro |
| **Analgesic** | Whole plant (Aqueous/Methanolic) | Pain-relieving properties in animal models | Reduced pain response in models |
| **Anti-ulcer** | Whole plant (Aqueous/Methanolic) | Prevents ulcer formation in experimental models | Reduced gastric lesions & acidity |
| **Laxative** | Whole plant (Aqueous/Methanolic) | Exhibits laxative effects in animal models | Increased bowel movements |
| **Neuroprotective** | Not specified | Potential for treating Parkinson's disease (in silico studies) | CDK7 inhibition, neuroprotective potential |

## Safety and Toxicity Profile of *Tecomella undulata*

Preclinical safety and toxicity investigations into the medicinal plant *Tecomella undulata* have largely indicated a favorable safety profile, particularly for its bark extracts, while also identifying specific fractions that warrant caution. Acute toxicity studies in murine models demonstrated a high level of safety, with one bark fraction showing no signs of toxicity up to an oral dose of 1500 mg/kg. Furthermore, studies focusing on the therapeutic effects, such as hepatoprotection, have administered various methanolic extracts to rats for periods up to seven days without reporting significant adverse effects, supporting the drug's traditional use. For quality control and commercial use in herbal formulations, standardization parameters mandated by pharmacopoeias (e.g., WHO guidelines) confirm the absence of concerning levels of heavy metals, aflatoxins, microbial load, and pesticidal residues in the stem bark powder, contributing to its overall safety assessment. Conversely, in vitro cytotoxicity assessments have provided mixed results, showing that while certain non-cytotoxic fractions exhibited desired hepatoprotective effects on HepG2 cells, two specific fractions (TSB-2 and MS-1) accounted for significant cell death. Interestingly, a methanolic extract (TUAM) demonstrated selective cytotoxicity on carcinoma cell lines (HepG-2 and A549) over normal VERO cells, as indicated by a decent selectivity index, but a different non-polar extract (hexane extract, TUAH) showed the most impact on locomotion in the *Caenorhabditis elegans* in vivo model, highlighting that the toxicity profile is highly dependent on the specific extract or fraction analyzed **[25,26,27]**. Taken together, the bulk of the evidence supports the relative safety of the crude extracts at therapeutic doses, though specific isolated phytochemicals or non-polar fractions may carry inherent toxicity.

## Conclusion

The body of evidence reviewed affirms *T. undulata* as a rich source of pharmacologically active phytoconstituents, including quinonoids, iridoid glucosides, and flavonoids, which collectively underpin its broad therapeutic profile. Traditional Ayurvedic and folk applications—specifically for treating liver and spleen disorders (hepatosplenomegaly), various skin ailments, and as a blood purifier—have found strong scientific validation. Preclinical studies robustly support its potent hepatoprotective, anti-inflammatory, analgesic, and antimicrobial activities, with recent studies offering compelling data on its potential in managing complex diseases like non-alcoholic steatohepatitis (NASH).

Despite the wealth of promising in vitro and in vivo data, a critical research gap remains in the translation to human medicine. The current literature often relies on crude or semi-purified extracts, which warrants future efforts toward bio-guided isolation of specific active compounds. Moreover, the lack of rigorous, well-designed human clinical trials represents the most significant hurdle to its acceptance in modern pharmacopeias.

In summation, *T. undulata* is a valuable candidate for drug development, offering safer and potentially more accessible therapies. Future research must prioritize the standardization of extracts, comprehensive toxicological assessments of isolated compounds, and robust clinical validation to fully harness the plant's therapeutic capacity. Crucially, given its status as an endangered species, research must also be coupled with urgent conservation strategies to ensure the sustainable utilization of this vital medicinal resource.

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