Review Article

Terminalia bellirica (Gaertn.) Roxb.: a versatile tree species of Jharkhand, India

Anuradha Das

Department of Botany, Sindri College Sindri, Binod Bihari Mahto Koylanchal University, Dhanbad, Jharkhand, India

Email-Id: anuradha.das84@gmail.com

Licensed under a Creative Commons Attribution 4.0 International License

Abstract

Terminalia bellirica (Gaertn.) Roxb., commonly known as Lopong (Santali), Bibhitaki (Sanskrit) or Baheda (Hindi), Bastard Myrobalan (English) is an important medicinal tree species of Jharkhand belonging to the family Combretaceae. Widely distributed throughout South and Southeast Asia, the species occupies economically significant position in the herbal medicines. It constitutes one of the three ingredients of the renowned Ayurvedic formulation *Triphala* and has been extensively used in traditional systems of medicine, particularly Horopathy, Ayurveda, Siddha, Unani, and Tibetan medicine. The fruits of *T. bellirica* are traditionally used to treat various health disorders like respiratory disorders, digestive ailments, microbial infections, metabolic diseases and inflammatory conditions. Besides, these are also used to extract natural dyes for traditional *Batik painting* of West Bengal. Ecologically, the species supports wildlife by providing food and shelter, facilitates natural regeneration through seed dispersal, and contributes to soil conservation and nutrient cycling. Owing to its medicinal, economic and ecological significance, *T. bellirica* represents a valuable forest resource that warrants sustainable management and conservation for future generations.

Keywords: Ayurveda, Conservation. Herbal medicines, Sustainable management

Introduction

Terminalia bellirica (Gaertn.) Roxb., commonly known as Bibhitaki or Baheda, is a large deciduous tree of Jharkhand state belonging to the family Combretaceae (Rath et al., 2024). The species is widely distributed throughout the tropical and subtropical regions of South and Southeast Asia, including India, Nepal, Sri Lanka, Bangladesh, Myanmar, Thailand, and parts of Southeast China (Gupta et al., 2020). In India, it occurs naturally in moist and dry deciduous forests, riverine habitats, and mixed forest ecosystems extending across the Himalayan foothills, Central India, the Eastern and Western Ghats, almost throughout Jharkhand and several forested landscapes of Odisha. Due to its immense medicinal value and long history of traditional use, *T. bellirica* occupies

a distinguished place in Horopathy, Ayurveda, Siddha, Unani and other indigenous healthcare systems (Bairwa et al., 2025). Bibhitaki is one of the three constituent species of Triphala, one of the most celebrated Ayurvedic formulations, along with *Terminalia chebula* and *Phyllanthus emblica* (Peterson et al., 2017). Phytochemical studies have revealed the presence of numerous bioactive constituents, including tannins, gallic acid, ellagic acid, flavonoids, lignans, and triterpenoids, which contribute to its antioxidant, antimicrobial, anti-inflammatory, hepatoprotective, antidiabetic, and cardioprotective properties and thus the fruits, have been prescribed for respiratory disorders, digestive ailments, eye diseases, liver disorders and various inflammatory conditions (Jayesh et al., 2019). Recent scientific investigations have validated many of these traditional applications and demonstrated a broad spectrum of pharmacological activities associated with its rich phytochemical composition. The growing global demand for herbal medicines and plant-derived therapeutic compounds has renewed scientific interest in *T. bellirica*. Despite its widespread use and considerable importance, information concerning its taxonomy, distribution, ecology, phytochemistry, therapeutic potential, and economic significance remains dispersed across diverse sources.



Figure 1: Flowers and leaves of *T. bellirica*

Therefore, a comprehensive review is necessary to synthesize existing knowledge and provide an updated understanding of this valuable tree species. Such a review is highly relevant for researchers, conservation biologists, foresters, pharmaceutical scientists, and policymakers engaged in medicinal plant research, biodiversity conservation and sustainable resource management. The present review aims to consolidate available information on the distribution, botanical characteristics, ecological significance, traditional uses, phytochemistry, pharmacological properties, and economic importance of *T. bellirica*, while emphasizing the need for its conservation and sustainable utilization.

Distribution and habitat

Terminalia bellirica is widely distributed throughout the Indian subcontinent and other parts of South and Southeast Asia (Fayed et al., 2024). It commonly occurs in moist deciduous, dry deciduous, and semi-evergreen forests, particularly in riverine and lowland habitats. The species thrives in regions receiving annual rainfall ranging from 750 to 3000 mm and grows well on deep, fertile alluvial, loamy, and lateritic soils. It is generally found from sea level up to elevations of about 1200 m. In Jharkhand, the species is commonly encountered in almost all forest divisions. It frequently occurs in association with species such as *Shorea robusta*, *Terminalia chebula*, *Terminalia arjuna*, *Lagerstroemia parviflora* and *Anogeissus latifolia*.

Botanical description

T. bellirica is a large deciduous tree attaining a height of 20–40 m with a straight cylindrical bole and a broad, spreading crown. The bark is bluish-grey to ash-coloured with shallow vertical cracks. Leaves are simple, large, broadly elliptic to obovate, measuring 10–25 cm long, and are clustered near the ends of branches. The young leaves are covered with silky hairs, while mature leaves become glabrous and glossy. Flowers are small, greenish-yellow, and arranged in axillary spikes (Figure 1). Flowering generally occurs from March to May. The fruit is a nearly globose, greyish to yellow-brown drupe measuring 2–4 cm in diameter and covered with fine velvety hairs. When mature the fruit's rind is grey or greyish-brown and has a slightly wrinkled appearance. Each fruit contains a hard seed enclosed within a thick fibrous pericarp (Figure 2). Fruiting usually takes place between November and February (Saxena and Brahmam, 1995).

Ecological importance

T. bellirica is an ecologically significant forest tree substantially valued to agro-forestry, ecosystem productivity and biodiversity conservation. Its fruits serve as an important food source for numerous wildlife species, including favourite fruits of monkeys, langurs, deer, squirrels, bats,

various birds and cattle. These animals assist in seed dispersal, thereby promoting natural regeneration and maintaining forest dynamics. The large canopy provides nesting, roosting, and sheltering sites for birds and arboreal mammals, while its shade creates favourable microhabitats for understory vegetation. The species also plays a crucial role in soil and water conservation. Its extensive root system stabilizes soil, minimizes erosion, and improves watershed protection. The decomposition of leaf litter enriches soil organic matter, enhances nutrient cycling, and improves moisture retention. As a native component of tropical forest ecosystems, *T. bellirica* supports diverse insect communities, pollinators, birds, and mammals, thereby strengthening ecological interactions and contributing to long-term ecosystem stability and resilience (Kong et al., 2023).



Figure 2: Fruits of *T. bellirica*

Traditional uses

The fruits of *T. bellirica* have been extensively utilized in traditional medicine systems across Asia for centuries. In Ayurveda, Bibhitaki is regarded as one of the most important medicinal fruits and is a key component of the renowned Triphala formulation. It has several nutritional components (Table 1). The fruits are traditionally used for treating respiratory disorders. Green fruit's decoction is effective in cough, bronchitis, asthma, and hoarseness of voice. Fruit pulp along with salt and Long Pepper is effective in infections of Throat and Chest (Bodding, 1925). They are also prescribed in traditional remedies for digestive ailments, constipation, diarrhoea, dyspepsia,

intestinal parasites, and liver disorders. In Siddha and Unani medicine, the fruits are employed as an astringent, expectorant, laxative and rejuvenating tonic (Albana et al., 2023). Various parts of the plant, including fruits, bark, and seeds, are used in the treatment of eye diseases, skin disorders, fever, hypertension and diabetes. The bark of the tree has been effectively used to treat urinary complaints (Bodding, 1925). Thus, it promotes overall health and enhances the quality of life. Due to its therapeutic potential, it continues to be an important component of traditional and modern herbal medicine.

Therapeutic properties

Phytochemical studies have revealed that *T. bellirica* contains a rich diversity of bioactive compounds, including tannins, gallic acid, ellagic acid, ethyl gallate, chebulagic acid, lignans, flavonoids, β-sitosterol, and triterpenoids. These compounds are responsible for a broad spectrum of pharmacological activities reported in both in vitro and in vivo studies. Scientific investigations have demonstrated significant antioxidant, anti-inflammatory, antimicrobial, antiviral, antifungal, hepatoprotective, cardioprotective, antidiabetic, hypolipidemic, anticancer, and immunomodulatory activities. The fruit extracts have shown promising effects in reducing oxidative stress, improving glucose metabolism, lowering serum cholesterol, and protecting liver tissues from toxic damage. These findings support the traditional medicinal uses of the species and highlight its potential as a source of novel therapeutic agents.

Table 1: Nutritional value of *T. bellirica* fruits (Kumar et al., 2023)

Nutrients	Value
Carbohydrates	20.26 ± 0.96
Fats	94.42 ± 0.63
Fibres	6.24 ± 1.62
Proteins	6.94 ± 0.03
Potassium	3.37 ± 0.11
Phosphorous	0.34 ± 0.018
Calcium	3.50 ± 0.30
Nitrogen	3.40 ± 0.06
Zinc	50.83 ± 1.32
Sodium	2.34 ± 0.21
Iron	294.06 ± 24.05

Copper	65.06 ± 0.84
Magnesium	0.36 ± 0.01

Economic importance

T. bellirica is a multipurpose tree species of considerable economic importance. The fruits are extensively traded as raw material for traditional medicine and constitute one of the three ingredients of the well-known Ayurvedic formulation *Triphala*. The high tannin content of the fruits especially its rind makes them valuable in the leather tanning and dyeing industries. These produce yellow to brown shades on the textiles and are thus used as natural dyes for traditional *Batik painting* of West Bengal (Sarwono et al., 2021) and inks. The wood is moderately hard and durable and is used locally for construction, agricultural implements, packing cases, furniture, plywood, and fuelwood. The kernels contain edible oil that has potential industrial applications. Collection and marketing of fruits provide supplementary income to forest-dependent communities in many parts of India. Owing to its diverse applications and sustained commercial demand of its fruits, bark, seeds and wood *T. bellirica* remains an important non-timber forest product species. Thus, it provides livelihood opportunities and the herbal medicine industry that contributes significantly to rural economy.

Conclusion

T. bellirica is a diversely utilized tree species of Jharkhand state with applications in traditional medicine, dye production and agroforestry. Its fruits have or been valued for centuries in traditional medicine systems and continue to play a vital role in modern herbal healthcare. The species contributes significantly to forest biodiversity, wildlife sustenance, soil conservation, and ecosystem functioning while supporting rural livelihoods through the trade of its fruits and other products. Increasing pressure from habitat degradation, overharvesting, and changing land-use patterns necessitates effective conservation and sustainable management strategies. Strengthening habitat protection, promoting large-scale plantation programmes, and encouraging scientific research on its medicinal potential will help ensure the long-term conservation and sustainable utilization of this valuable forest resource.

References

Albana U, Mohammad H, Mohd A and Syeda SZ. (2023). Efficacy of *Terminalia Bellirica* (Balela): a review. Indian Journal of Unani Medicine. 16(2): 138-142.

Bairwa VK, Kashyap AK, Meena P and Jain BP. (2025). Triphala's characteristics and potential therapeutic uses in modern health. International Journal of Physiology, Pathophysiology and Pharmacology. 17(2): 19–36.

Bodding PO. (1925). Studies in Santhal medicine and connected folklore-II. Santals and Diseases. Mem. Asiatic Society of Bengal. 10(1): 1-132.

Fayed RH, Ali SE, Yassin AM, Madian K and Bawish BM. (2024). *Terminalia bellirica* and *Andrographis paniculata* dietary supplementation in mitigating heat stress-induced behavioral, metabolic and genetic alterations in broiler chickens. BMC Veterinary Research. 20(1): 388. DOI: 10.1186/s12917-024-04233-2

Gupta, A., Kumar, R., Bhattacharyya, P., Bishayee, A., & Pandey, A. K. (2020). *Terminalia bellirica* (Gaertn.) Roxb. (Bahera) in health and disease: A systematic and comprehensive review. Phytomedicine: International Journal of Phytotherapy and Phytopharmacology. 77: 153278. DOI: 10.1016/j.phymed.2020.153278

Jayesh K, Helen LR, Vysakh A, Binil E and Latha MS. (2019). Protective Role of *Terminalia bellirica* (Gaertn.) Roxb Fruits Against CCl_4 Induced Oxidative Stress and Liver Injury in Rodent Model. Indian Journal of Clinical Biochemistry. 34(2): 155–163.

Kong Q, Shang Z, Liu Y, Fakhar-E-Alam Kulyar M, Suo-Lang S, Xu Y, Tan Z, Li J and Liu S. (2023). Preventive effect of *Terminalia bellirica* (Gaertn.) Roxb. extract on mice infected with *Salmonella Typhimurium*. Frontiers in Cellular and Infection Microbiology. 12: 1054205. DOI: 10.3389/fcimb.2022.1054205

Kumar A, Gupta RK and Kumar. A (2023). *Terminalia bellerica*: a wonderful medicinal tree, Just Agriculture (Multidisciplinary e-Newsletter). 3(10): 457-459.

Peterson CT, Denniston K and Chopra D. (2017). Therapeutic Uses of Triphala in Ayurvedic Medicine. Journal of Alternative and Complementary Medicine. 23(8): 607–614.

Rath SK, Mishra S, Mishra AK, Kumar S and Sureshrao GA. (2024). *Terminalia bellirica* (Gaertn.) Roxb. (Combretaceae): a medicinal tree of India. Medicinal Combretaceae of India, Volume I. Ambika Prasad Research Foundation, Odisha, India. 36-45.

Sarwono, Darwoto and Mataram S. (2021). Natural Batik Dyes from *Terminalia bellirica, Ceriop condolleana, Cudrania javanensis* and *Pelthopherum pterocarpum*. IOP Conference series: Earth and Environmental Science. 905 (1): 012019. DOI:10.1088/1755-1315/905/1/012019

Saxena HO and Brahmam M. (1995). The Flora of Orissa, Volume II. Regional Research Laboratory, Bhubaneswar and Orissa Forest Development Corporation Limited, Bhubaneswar, Odisha, India.