INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: https://www.ijpsjournal.com

OPEN ACCESS

Review Article

Zanthoxylum Oxyphyllum: A Comprehensive Review of its Ethnobotany, Phytochemistry, and Pharmacological Potential

B. Balamurugan*, Dr. Sheik Nasar I

East Point College of Pharmacy, Bangalore, Karnataka, India.

ARTICLE INFO

Published: 30 Jun 2026
Keywords:
Antidiabetic activity, Medicinal plants, Pharmacological mechanisms, Blood glucose regulation, Herbal therapy
DOI:
10.5281/zenodo.21072498

ABSTRACT

Zanthoxylum oxyphyllum belongs to the Rutaceae family and occupies a firm place in the folk medicine of South and Southeast Asia, particularly across its tropical and subtropical reaches. For generations, traditional healers in this region have reached for the plant when treating open wounds, easing pain, calming inflammation, and clearing up skin infections. This review pulls together what has been published so far on the phytochemistry and pharmacology of Z. oxyphyllum, working from existing experimental data to weigh its potential as a therapeutic agent. Researchers working with hydroethanolic and chloroform leaf extracts have reported several biological effects worth noting: antioxidant action, reduced pain sensitivity, anti-inflammatory effects, suppression of bacterial growth, and faster wound healing. The plant appears to owe these effects to its mix of secondary metabolites, among them alkaloids, flavonoids, terpenoids, lignans, and coumarins. Standard experimental techniques, including the hot plate test and the excision wound model, have given scientific backing to claims that traditional medicine has held for a long time. Acute toxicity testing also points toward a reasonable safety margin at the doses studied so far. Even so, preclinical findings alone cannot stand in for proper clinical trials. Pinning down the exact active compounds, working out their mechanisms at the molecular level, and confirming safety and effectiveness in human patients are the next essential steps. Taken together, the evidence makes a strong case for Z. oxyphyllum as a pharmaceutically promising but still underexamined plant, and this review calls for more focused research to close that gap.

INTRODUCTION

Few plant families match Rutaceae for sheer aromatic diversity. Its members are scattered across tropical and temperate regions worldwide, and the family has long drawn the interest of both folk healers and pharmacognosists because so many of its species carry biologically active compounds. Alkaloids, flavonoids, and volatile oils show up again and again in phytochemical

***Corresponding Author:** B. Balamurugan
Address: *East Point College of Pharmacy, Bangalore, Karnataka, India.*
Email : balamuruganb939@gmail.com
Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

surveys of the family, and these compounds account for much of the medicinal reputation Rutaceae species enjoy. Within this family, the genus Zanthoxylum stands out. Found across Asia, Africa, and the Americas, Zanthoxylum species have woven themselves into indigenous healing traditions over many generations, typically used against pain, inflammation, and microbial infection, along with a range of other complaints — a usage pattern that mirrors just how chemically varied the genus is.One member of this genus that merits closer scientific attention is Zanthoxylum oxyphyllum, native to the Eastern Himalaya and the hill states of north-eastern India. Its chemistry — built around alkaloids, flavonoids, terpenoids, and coumarins — suggests it could be medicinally useful in more than one way. This article draws together current knowledge on the taxonomy, distribution, chemical makeup, and pharmacological activity of Z. oxyphyllum, with the goal of giving future researchers a single point of reference.

Botanical Description

Botanical name	Zanthoxylum oxyphyllum
Kingdom	Plantae
Sub-Kingdom	Viridiplantae
Domain	Eukaryota
Phylum/Division	Tracheophyta
Sub-Phylum	Euphyllophytina
Class	Magnoliopsida
Subclass	Rosidae
Order	Sapindales
Family	Rutaceae
Genus	Zanthoxylum
Species	Oxyphyllum [7]

Vernacular Names

Language	Vernacular Name
Assamese	Mejenga / Mezenga
Mishing	Onger
Nagaland	Inthapching
Hindi / Trade	Timur
English	Prickly Ash
Chinese	Jianye Huajiao

Geographical Distribution

Z. oxyphyllum favours the temperate and subtropical stretches of Asia, with the Himalayan belt as its main territory. It has been documented in India, Nepal, Bhutan, Myanmar, and China. Inside India specifically, the species clusters in the north-east — Assam, Arunachal Pradesh, Meghalaya, Manipur, Sikkim, and West Bengal — climbing to elevations near 2,700 metres. It tends to favour forest margins, valley floors, hillsides, and damp montane forest. Between its hardiness and its long medicinal track record, the plant has earned a solid reputation as a culturally important species of the Eastern Himalayan region. [12–17]

Macroscopical Characteristics

Z. oxyphyllum grows as a small-to-medium aromatic shrub or tree in the Rutaceae family. It's easy to pick out in the field thanks to its spine-covered stems, scented leaves, and characteristic fruit. [18]

Parameters	Leaves	Bark	Fruit
Color	Dark green above, pale brown below	Greyish brown	Green when young, darkening to brown or black as it matures
Shape	Lance-shaped to oval, tapering to a point	Coarse, dotted with small spines	Small and rounded
Size	4–10 cm long	Thickness varies	4–6 mm
Taste	Aromatic, pungent	Bitter, pungent	Sour and spicy
Odour	Strongly aromatic	Has a distinct aromatic smell	Strongly aromatic
Texture	Smooth	Rough and hard	Hard outer shell

Fig. 1 [Leaves]

Fig. 2 [Bark]

Fig. 3 [Fruit]

Phytochemical Constituents

What gives Z. oxyphyllum its medicinal standing is the range of secondary metabolites packed into the plant. Alkaloids are arguably the most pharmacologically important group here — zanoxyline and rhetsinine, both isolated from the stem bark, are usually singled out as the main bioactive alkaloids. Flavonoids, especially derivatives of quercetin and kaempferol, add meaningful antioxidant strength. The essential oil fraction contributes monoterpenes and sesquiterpenes, which account for the plant's characteristic smell as well as part of its biological activity. Coumarins — both the simple kind and furanocoumarins — broaden the pharmacological picture further still, while lignans round out the chemical profile and lend extra weight to the plant's traditional uses. [21–22]

Phytochemical Properties

- Alkaloids — linked to antimicrobial and analgesic effects
- Terpenoids — show anti-inflammatory and antimicrobial activity
- Flavonoids — provide antioxidant and free-radical-scavenging effects
- Steroids — contribute anti-inflammatory and broader therapeutic effects
- Tannins — display antimicrobial and antioxidant activity
- Glycosides — associated with cardioprotective and other medicinal effects
- Phenolic compounds — strong antioxidant activity
- Saponins — not detected in the extract

Pharmacological Activity [23]

1. Anti-inflammatory Activity

A good number of studies on Zanthoxylum species (Rutaceae) report clear anti-inflammatory effects across different experimental setups. Methanol, ethanol, and aqueous extracts have all shown

activity in vitro — in protein denaturation assays and membrane stabilisation tests, for instance — as well as in vivo, in models such as carrageenan-induced paw oedema. The mechanism seems to revolve around dialing down pro-inflammatory mediators: cyclooxygenase enzymes, nitric oxide, tumour necrosis factor-alpha, and several interleukins. Alkaloids, flavonoids, and terpenoids are thought to drive most of this effect. For Z. oxyphyllum in particular, though, the bulk of this evidence is borrowed from studies on the wider genus rather than the species itself, so species-specific confirmation is still very much needed.

2. Antimicrobial Activity

Zanthoxylum extracts and essential oils have repeatedly shown the ability to hold back microbial growth across a broad range of organisms. Gram-positive bacteria like Staphylococcus aureus, Gram-negative bacteria like Escherichia coli, and fungi such as Candida species have all tested susceptible in disc diffusion and minimum inhibitory concentration assays. This effect is generally attributed to disruption of microbial cell membranes and interference with key enzymes, with alkaloids, amides, and volatile terpenoids doing most of the work. Essential oils, notably, tend to outperform crude extracts on this front.

3. Antioxidant Activity

Researchers have measured the antioxidant capacity of Zanthoxylum species using a battery of standard assays — DPPH, ABTS, FRAP, and nitric oxide scavenging among them. Methanolic and ethanolic extracts consistently scavenge free radicals in a dose-dependent manner, and this activity tracks closely with how much total phenolic and flavonoid content the extract contains. Electron donation and hydrogen atom transfer appear to be the main mechanisms at play, both of which help neutralise reactive oxygen species. This antioxidant capacity matters directly for protecting cells against lipid peroxidation and oxidative damage.

4. Anticancer Activity

Cell-based studies have reported cytotoxic and antiproliferative effects of Zanthoxylum species against several cancer cell lines — MCF-7 breast cancer cells, HeLa cervical cancer cells, A549 lung cancer cells, and colon carcinoma lines — typically assessed using MTT assays alongside apoptosis analysis. The proposed mechanisms include triggering apoptosis, activating mitochondrial pathways, and arresting the cell cycle, with alkaloids, lignans, and coumarins flagged as the likely active agents. That said, almost all of this evidence comes from cell culture work; nothing clinically validated exists yet for Z. oxyphyllum specifically. Filling that gap with in vivo and mechanistic studies focused on this species should be a research priority going forward.

Traditional Uses of Zanthoxylum oxyphyllum [24–25]

The folk medicine uses recorded for Z. oxyphyllum closely track what's been reported for other Zanthoxylum species, which show up repeatedly in traditional healing systems across Asia and Africa. Different parts of the plant bark, seeds, fruit — get used for different purposes in folk practice.

Bark

Traditional healers reach for the bark when dealing with toothache, rheumatic pain, and other inflammatory complaints. It's also made into pastes or decoctions and applied directly to wounds, skin infections, and other conditions

involving microbial activity — a use that lines up well with the analgesic, anti-inflammatory, and antiseptic properties suggested by its chemistry.

Seeds

The seeds have a reputation as a carminative and digestive aid. They're traditionally used for abdominal discomfort, indigestion, and general gastrointestinal upset, and folk practice also credits them with mild antimicrobial activity.

Fruits

In traditional accounts, the fruits are used against fever, gastrointestinal trouble, and respiratory complaints. Because of their strong aroma, they've also found a place as a digestive tonic and general wellness supplement in traditional healthcare practice.

REFERENCES

1. Pollio A, De Natale A, Appetiti E, Aliotta G, Touwaide A. Continuity and change in the Mediterranean medical tradition: Ruta spp. (Rutaceae) in Hippocratic medicine and present practices. J Ethnopharmacol. 2008;116(3):469–482.
2. Mabberley DJ. Mabberley's Plant-book: A Portable Dictionary of Plants, Their Classification and Uses. 4th ed. Cambridge: Cambridge University Press; 2017.
3. Groppo M, Pirani JR. A new species of Zanthoxylum (Rutaceae) with a key to the species from Northeastern Brazil. Phytotaxa. 2017;314(2):259–265.
4. Ombito JO, Chi GF, Wansi JD. Ethnomedicinal uses, phytochemistry, and pharmacology of the genus Zanthoxylum: A review. Curr Org Chem. 2021;25:1–23.
5. Okagu IU, Ndefo JC, Aham EC, et al. Zanthoxylum species: A comprehensive review of traditional uses, phytochemistry, and pharmacological studies. Front Pharmacol. 2021;12:713090.
6. Hajra PK, Nair VJ, Daniel P. Flora of India. Vol. 4. Kolkata: Botanical Survey of India; 1997.
7. Annappan U, Rajkishore VB, Ramalingam RA. Review on Zanthoxylum alatum Roxb. Res J Pharmacog Phytochem. 2015;7(4):223–226.
8. Hajra PK, Nair VJ, Daniel P. Flora of India, Vol. 4. Kolkata: Botanical Survey of India; 1997. p. 385. India Biodiversity Portal.
9. Kanjilal UN. Flora of Assam, Vol. 1. New Delhi: Omsons Publications; 2005. p. 201. India Biodiversity Portal.
10. Singh NP, Chauhan AS, Mondal MS. Flora of Manipur, Vol. 1. Kolkata: Botanical Survey of India; 2000. p. 210. India Biodiversity Portal.
11. India Biodiversity Portal. Zanthoxylum oxyphyllum Edgew. Accessed June 2026.
12. Hooker JD. The Flora of British India. Vol. 1. London: L. Reeve & Co.; 1875.
13. Hajra PK, Nair VJ, Daniel P. Flora of India. Vol. 4. Kolkata: Botanical Survey of India; 1997.
14. Kanjilal UN, Kanjilal PC, Das A. Flora of Assam. Vol. 1. Dehradun: Bishen Singh Mahendra Pal Singh; 1934.
15. Singh NP, Chauhan AS, Mondal MS. Flora of Manipur. Vol. 1. Kolkata: Botanical Survey of India; 2000.
16. Wu ZY, Raven PH, Hong DY. Flora of China. Vol. 11. Beijing & St. Louis: Science Press and Missouri Botanical Garden Press; 2008.
17. Polunin O, Stainton A. Flowers of the Himalaya. New Delhi: Oxford University Press; 1984.
18. Flora of India. Hajra PK, Nair VJ, Daniel P. Vol. 4. Kolkata: Botanical Survey of India; 1997.

19. Alam F, Us Saqib QN. Pharmacognostic study and development of quality control parameters for fruit, bark and leaves of Zanthoxylum armatum (Rutaceae). Ancient Sci Life. 2015;34(3):147–155.
20. Tiwari KP, Minocha PK, Sharma ND. Zanoxyline—A new alkaloid from stem bark of Zanthoxylum oxyphyllum. Phytochemistry. 1979;18(3):517–518.
21. Negi JS, Bisht VK, Bhandari AK, Singh P, Sundriyal RC. Chemical constituents and biological activities of genus Zanthoxylum: A review. African Journal of Pure and Applied Chemistry. 2011;5(12):412–416.
22. Bhattacharyya B, Sharma HK. Phytochemical and medicinal properties of Zanthoxylum species. Journal of Medicinal Plants Research. 2014;8(15):620–628.
23. Okagu IU, Ndefo JC, Aham EC, Udenigwe CC. Zanthoxylum species: a review of traditional uses, phytochemistry and pharmacology in relation to cancer, infectious diseases and sickle cell anemia. Frontiers in Pharmacology. 2021;12:713090. https://doi.org/10.3389/fphar.2021.713090
24. Mutinda ES, et al. J Ethnopharmacol. 2023. https://doi.org/10.1016/j.jep.2022.115593
25. Wen et al. Heliyon. 2024. https://doi.org/10.1016/j.heliyon.2024.e25083

HOW TO CITE: B. Balamurugan, Dr. Sheik Nasar I, Zanthoxylum Oxyphyllum: A Comprehensive Review of its Ethnobotany, Phytochemistry, and Pharmacological Potential, Int. J. of Pharm. Sci., 2026, Vol 4, Issue 6, 7797-7802. https://doi.org/10.5281/zenodo.21072498