

A review on ethnomedicinal uses, phytochemical profile and pharmacological properties of *Tetrastigma leucostaphylum* (Dennst.) Alston ex Mabb.

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Key words: *Tetrastigma leucostaphylum*, Vitaceae, Taxonomy, Pharmacognosy, Phytochemistry

Received: March 15, 2026 **Accepted:** March 29, 2026 **Published:** April 03, 2026

DOI: <https://dx.doi.org/10.12692/ijb/28.4.1-7>

ABSTRACT

Tetrastigma leucostaphylum (Dennst.) Alston ex Mabb. (Vitaceae) is a woody climber widely distributed in tropical and subtropical regions of Asia. Traditionally used for the treatment of diarrhea, fever, inflammation, and other ailments, this species has recently attracted scientific attention due to its pharmacological and phytochemical potential. The present review compiles available literature on its taxonomy, ethnomedicinal uses, pharmacognostical standards, phytochemical composition, GC-MS profiling, nutritional value, and biological activities. A comprehensive review of both national and international literature was performed by searching established databases using relevant keywords to identify published articles. Phytochemical investigations indicate the presence of alkaloids, flavonoids, saponins, steroids, diterpenes, and fatty acids. GC-MS analyses of various extracts identified bioactive compounds including 2,4-di-tert-butylphenol, fatty acid derivatives, squalene, and 5-hydroxymethylfurfural. Pharmacological studies revealed antidiarrheal, anti-inflammatory, neuropharmacological, cytotoxic, and acaricidal activities. Despite promising findings, further bioactivity-guided isolation and clinical validation are required.

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INTRODUCTION

Traditional medicinal plants have been used as remedies for many illnesses since ancient times. Plant materials are prepared in different forms such as infusions, decoctions, powders, or pastes, and are widely used in traditional healing systems across the world (Xic *et al.*, 2026).

Various parts of Africa, Asia, and particularly India, have rich traditional heritage of medicinal practices such as those from ayurveda, siddha and unani used together with mainstream healthcare treatments (Aggarwal *et al.*, 2024). Interest in herbal medicine has grown considerably in the world, and it has been estimated that around 80% of the world's population depends on plant-based medicines for the betterment of healthcare (Balekundri and Mannur, 2020). Many important modern medicines have been discovered through knowledge insights from the traditional usage of medicinal plants (Balunas and Kinghorn, 2005). Scientific studies have validated many traditional claims regarding medicinal plants, paving the way for the development and commercialization of various herbal products (Ernst, 2021).

Tetrastigma leucostaphylum (Dennst.) Alston ex Mabb. is a woody climber of Vitaceae and widely distributed in the subtropical and tropical areas of Asia, Malaysia and Australia.

Traditionally, the leaf extract of this plant is used to treat several illnesses such as, diarrhoea, stomach disorders, stomach ache and tumors (Rudra *et al.*, 2020) in addition, the root extract also used to treat fever, gout and oedema in many tribes of Bangladesh (Rudra *et al.*, 2021).

Till date, there are a few literatures only available for the scientific evaluation of the medicinally potential of *T. leucostaphylum*. The reported studies in this plant includes acaricidal (Krishna *et al.*, 2014), anti-diarrheal, cytotoxic (Rudra *et al.*, 2020), neuropharmacological and antiproliferative activities (Rudra *et al.*, 2023).

This mini review describes the detailed information about the chemical constituents, pharmacological aspects of the extracts from the plant, which could be helpful for future investigations and the processes in drug discovery.

Geographical distribution

T. leucostaphylum is widely distributed in subtropical and tropical areas of Asia and Australia. In India, this species has been documented from the Western Ghats of Kerala (Adarsh *et al.*, 2013), Karnataka (Madar *et al.*, 2025) and Tamil Nadu (Stephy *et al.*, 2022). In Bangladesh, the plant occurs mainly in the Chittagong Hill Tracts and Sylhet regions (Rudra *et al.*, 2020). The plant grows naturally in tropical forest ecosystems as a woody liana and prefers moist woodland habitats. Anatomical studies have also been conducted to clarify stem and root structures due to its significant ecological association with *Rafflesia* species (Mursidawati *et al.*, 2021).

Ethnomedicinal uses

T. leucostaphylum has long been recognised in traditional systems of medicine for the management of various ailments. In Kerala, India, tribal communities have traditionally used the leaves of this plant for medicinal uses, highlighting its ethnobotanical importance in the Western Ghats region (Adarsh Krishna *et al.*, 2013). In Bangladesh, several indigenous communities use the plant extensively in folk medicine. The leaves are commonly used to treat diarrhoea, stomach disorders and stomach ache, while leaf juice is specifically administered for diarrhoeal conditions. In addition, leaf paste is applied externally for the management of tumours, and root preparations are utilised for treating fever, gout and oedema (Rudra *et al.*, 2020). The plant has also been documented in folk medicine for the treatment of headache and fever (Umesh *et al.*, 2025). Collectively, these widespread traditional applications have stimulated scientific investigations aimed at validating and understanding the pharmacological properties of *T. leucostaphylum*.

Taxonomical, morphological and anatomical characteristics

Systematic position

Kingdom -Plantae

Phylum -Streptophyta

Class- Equisetopsida

Subclass -Magnoliidae

Order -Vitales

Family -Vitaceae

Genus -*Tetrastigma*

Species -*Tetrastigma leucostaphylum*

T. leucostaphylum is a woody climbing vine that belongs to the Vitaceae family (Fig. 1). It is known for characterised by tendrilled climbers, dioecious flowers and four-lobed stigmas (Yeni *et al.*, 2018). Taxonomically, the species was previously confused with *T. lanceolarium* and *T. rafflesiae*, but detailed nomenclatural revision established *T. leucostaphylum* as a distinct and valid species (Rahayu *et al.*, 2018). Morphologically, it is a vigorous climber with palmately compound leaves, although simple and trifoliate forms may also occur; the leaflets are oblong-lanceolate with a cuneate base, coarsely serrated margins and an acute apex, and the petioles are warty-lenticellate (Adarsh *et al.*, 2014). The plant produces subglobose berries with a sour-sweet edible pericarp (Umesh *et al.*, 2025). Organoleptic evaluation of leaf and stem showed characteristic colour, odour and taste useful for crude drug identification (Stephy *et al.*, 2025). Anatomically, transverse sections of leaf and stem revealed diagnostic features such as druses (calcium oxalate crystals), idioblastic cells, well-developed vascular bundles and distinct epidermal layers (Stephy *et al.*, 2025). Stem sections exhibited compactly arranged vascular bundles with simple phloem bundles, distinguishing them from roots that show loosely arranged vascular tissues (Mursidawati *et al.*, 2021).

Powder microscopy demonstrated identifiable fragments of epidermal cells, xylem vessels, fibrous tissues and crystal aggregates, while scanning

electron microscopy (SEM) further confirmed surface morphology and cellular architecture (Stephy *et al.*, 2025).



Fig. 1. The habitat of *T. leucostaphylum*

Phytochemistry

Comprehensive phytochemical investigations of *T. leucostaphylum* have been reported across multiple studies using qualitative, quantitative and advanced analytical techniques.

Preliminary qualitative phytochemical screening of the ethanolic leaf extract demonstrated the presence of alkaloids, phytosteroids, saponins, diterpenes, cardiac glycosides, carbohydrates, fixed oils and fats (Adarsh *et al.*, 2013), while further pharmacognostical standardisation of leaf and stem confirmed broad classes of phytoconstituents and established authentication parameters (Stephy *et al.*, 2025). Quantitative phytochemical estimation was extensively performed on the fruit pericarp, where the methanolic extract contained total phenolics (7.12 mg GAE/g DW), total flavonoids (6.78 mg QE/g DW) and total alkaloids (0.78 mg BE/g DW), indicating significant antioxidant-associated compounds (Umesh *et al.*, 2025). Spectroscopic profiling supported these findings, as UV-Visible analysis revealed characteristic absorption maxima corresponding to conjugated chromophores, and FTIR spectra showed functional groups such as

hydroxyl (–OH), carbonyl (C=O) and aromatic C=C bonds, confirming the presence of phenolics and related secondary metabolites (Stephy *et al.*, 2025). Proximate analysis was conducted on different plant parts. Adarsh Krishna *et al.* (2013) analysed leaves and reported moisture (6.85%), carbohydrate (58.97%), protein (17.50%), fibre (12.00%), ash (13.78%), and fat (2.90%). Stephy *et al.* (2025) provided detailed proximate profiling of powdered leaf and stem; leaf contained moisture (7.01%), protein (19.18%), fibre (22.41%), ash (15.87%), and nitrogen-free extract (39.58%), while stem had moisture (8.47%), fibre (48.44%), ash (9.53%), and nitrogen-free extract (34.04%). Fruit pericarp composition included moisture (80.71%), carbohydrate (12.50%), protein (1.20%), fat (0.096%), fibre (3.85%), and ash (1.15%) (Umesh,

2025). Advanced phytochemical profiling using GC–MS was performed by Rudra *et al.*, where the dichloromethane fraction revealed ten compounds including 2,4-di-tert-butylphenol (Rudra *et al.*, 2020), and the n-hexane fraction in a later study also identified ten bioactive compounds associated with neuropharmacological and antiproliferative activity (Rudra *et al.*, 2023). Collectively, these studies demonstrate that *T. leucostaphylum* possesses a chemically diverse profile supported by preliminary screening, quantitative estimation, spectroscopic fingerprinting, proximate evaluation and GC–MS analysis, thereby providing a strong scientific basis for its reported pharmacological activities. Table 1 includes the list of major phytoconstituents identified from *T. leucostaphylum*.

Table 1. Chemical constituents identified from the different parts of *T. leucostaphylum*

Study	Plant part	Solvent	No. of compounds	Five major compounds identified
Rudra <i>et al.</i> , 2020	Leaf	Dichloromethane	10	Methyl elaidolinolenate; 2,4-di-tert-butylphenol; Palmitic acid; Methyl palmitate; Linolenic acid
Rudra <i>et al.</i> , 2023	Aerial parts	n-Hexane	10	Hexadecanoic acid; 6-Octadecenoic acid (Z); Octadecanoic acid; Fatty acid methyl ester derivative; Sterol-like compound
Umesh <i>et al.</i> , 2025	Pericarp	Methanol	24	5-Hydroxymethylfurfural (25.26%); Squalene; Hexadecanoic acid, methyl ester; n-Hexadecanoic acid; Octadecanoic acid

Pharmacological activities

Antidiarrhoeal activity

The traditional use of *T. leucostaphylum* for the treatment of diarrhoea among indigenous communities in Bangladesh has been scientifically validated by Rudra *et al.* (2020). In a castor oil-induced diarrhoea model in Swiss albino mice, the dichloromethane (DTL) fraction of the leaf extract showed notable dose-dependent antidiarrheal activity. At 400 mg/kg, DTL produced 88.01% inhibition of defecation, which was higher than the standard drug loperamide (75.44%). The extract also markedly reduced intestinal fluid accumulation (93.75% inhibition of weight and 91.17% inhibition of volume) and suppressed gastrointestinal motility (84.28% inhibition), with the highest antidiarrheal index (164.69%) recorded at the same dose. These results strongly support the ethnomedicinal claim and

suggest that the activity may be due to bioactive compounds that reduce intestinal secretion and motility.

Acaricidal activity

Adarsh *et al.*, 2014 has been reported the acaricidal potential of *T. leucostaphylum* by using the petroleum ether extract of its leaves against *Rhipicephalus (Boophilus) annulatus*. The study demonstrated dose-dependent activity in the adult immersion test, where a 10% extract produced 58.32% adult tick mortality. In addition to mortality, the extract significantly inhibited fecundity (88.96%) and reduced egg hatching (50%), indicating strong effects on both survival and reproductive capacity of ticks. The LC₅₀ value was reported as 10.46%, suggesting moderate potency. These findings have been revealed the potential of *T. leucostaphylum* as a

plant-based alternative to synthetic acaricides, possibly due to synergistic interactions among its bioactive constituents.

Antioxidant activity

A comprehensive antioxidant study on *T.leucostaphylum* was conducted using the fruit pericarp (Umesh *et al.*, 2025). The study mainly focused on evaluating the antioxidant potential through various *in vitro* assays. Phytochemical analysis demonstrated that the methanolic extract contained a high amount of total phenolics (7.12 mg GAE/g DW) and flavonoids (6.78 mg QE/g DW), which are important natural antioxidants. Among the tested solvents, methanol was found to be the most effective for extracting antioxidant compounds.

In the DPPH free radical scavenging assay, the methanolic extract exhibited the highest antioxidant activity (17.13 mg AAE/g DW). The total antioxidant capacity was recorded as 13.55 mg AAE/g DW, and the FRAP assay showed 7.56 mg AAE/g DW. These results clearly indicate that the fruit pericarp possesses significant free radical scavenging capability authors conclude that the strong antioxidant activity is mainly due to the presence of phenolic and flavonoid compounds in the pericarp. Overall, the study highlights that *T. leucostaphylum* fruit is a rich source of natural antioxidants and may

serve as a functional food or nutraceutical supplement.

Neuropharmacological activity

The neuropharmacological effect of *T. leucostaphylum* was assessed using in vivo behavioural models (Rudra *et al.*, 2023). The investigation examines the effects of the total extract and its different solvent fractions at doses of 100, 200 and 400 mg/kg body weight.

The results showed significant antidepressant and anxiolytic efficacy in experimental animals. In the Tail Suspension Test (TST) and Forced Swimming Test (FST), the extracts reduced immobility duration, which indicates antidepressant potential. In anxiety models such as the Elevated Plus Maze (EPM) and Open Field Test (OFT), the treated groups showed enhanced exploration behaviour compared to the control group. Among all tested fractions, the n-hexane fraction exhibited most potent neuropharmacological activity. GC-MS analysis of the active fraction identified multiple bioactive compounds. Molecular docking studies further suggested good binding affinity of these compounds with receptors related to depression and anxiety. The authors concluded that *T. leucostaphylum* possesses promising neuropharmacological potential, although further detailed mechanistic investigations are required to confirm its exact mode of action.

Table 2. Pharmacological effects of *T. leucostaphylum*

Study	Extract/Fraction	Activity	Experimental model	Key findings
Adarsh <i>et al.</i> , 2014	Petroleum ether	Acaricidal	Adult immersion test	LC ₅₀ = 10.46%; inhibited fecundity (88.96%)
Rudra <i>et al.</i> , 2020	DTL fraction	Antidiarrheal	Castor oil-induced model	Significant reduction in stool frequency and GI motility
Rudra <i>et al.</i> , 2020	Methanol extract	Analgesic, anti-inflammatory, thrombolytic	<i>In vivo</i> and <i>in vitro</i> assays	Dose-dependent inhibition of pain and clot lysis
Rudra <i>et al.</i> , 2023	n-Hexane fraction	Neuropharmacological and cytotoxic	Behavioural tests and cancer cell lines	IC ₅₀ (U-251) = 14.3 µg/mL
Umesh <i>et al.</i> , 2025	Fruit pericarp	Antioxidant	DPPH, FRAP, TAC assays	High antioxidant potential

Cytotoxic and antiproliferative activity

The cytotoxic and antiproliferative potential of *T. leucostaphylum* was evaluated scientifically using both *in vitro* and *in silico* approaches (Rudra *et al.*, 2023). In the study, different solvent fractions of

the aerial parts were tested against several human cancer cell lines, including MGC-803, A549, U-251, HeLa, and MCF-7. Among the tested fractions, the n-hexane fraction showed the strongest antiproliferative effect. It exhibited the highest

cytotoxicity against the U-251 glioblastoma cell line with an IC₅₀ value of 14.3 µg/mL. It also demonstrated notable activity against A549 (lung cancer), MGC-803 (gastric cancer), HeLa (cervical cancer), and MCF-7 (breast cancer) cell lines. GC-MS analysis identified several bioactive compounds, and molecular docking studies suggested good binding affinity of these compounds with target proteins related to cancer progression. In another study, cytotoxicity was assessed using the brine shrimp lethality bioassay. The dichloromethane fraction displayed the highest toxicity with an LC₅₀ value of 67.23 µg/mL (Rudra *et al.*, 2022). Overall, these findings indicate that *T. leucostaphylum* possesses promising cytotoxic and antiproliferative activities. The activity may be attributed to bioactive phytochemicals, but further detailed mechanistic and clinical studies- are required to confirm its therapeutic potential. Table 2 consolidates the pharmacological profile of *T. leucostaphylum*.

CONCLUSION

T. leucostaphylum is recognized as a medicinal plant with traditional and emerging pharmacological uses. It has been commonly used to treat diarrhoea, fever, stomach disorders and tumours ethnobotanically. Scientific studies have been confirmed that the plant possesses significant phytochemical constituents including alkaloids, flavonoids and phenolics.

Pharmacological studies are documented its antidiarrheal, acaricidal, neuropharmacological, antioxidant and cytotoxic activities. Even though the plant shows strong therapeutic potential, further detailed studies are needed to confirm safety, toxicity profile and mechanism of action before drug development. The plant's unique importance underscores the need for clinical and pharmacological studies to get wide information. This mini-review focuses on more of the studies on this plant and its constituents which might be helpful for future references.

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