



## Ethnomedical Properties of *Taxus Wallichiana* Zucc. (Himalayan Yew)

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### ABSTRACT

*Taxus wallichiana* Zucc., known as Himalayan yew, belongs to the family Taxaceae. It is a medium-sized, temperate, Himalayan forest tree of medicinal importance. In India, this evergreen tree is found at altitudes between 1800 and 3300 m above mean sea level (MSL). It has been used by the native populations for treating common cold, cough, fever, and pain. Its uses are described in Ayurveda and Unani medicine. It received attention recently as its leaves and bark were found to be the prime source of taxol, a potent anticancer drug. It possesses many other biological activities also. We focus on its importance in traditional medicine for its multiple medicinal properties.

**Key words:** Anticancer, Taxol, Traditional medicine

### INTRODUCTION

*Taxus wallichiana* Zucc., or Himalayan yew, belongs to the family Taxaceae and is found in India as an evergreen tree in the temperate Himalayas at altitudes between 1800 and 3300 m and in the hills of Meghalaya and Manipur at an altitude of 1500 m.<sup>[1]</sup> *Taxus* is distributed in Europe, North America, North India, Pakistan, China, and Japan.<sup>[1]</sup> It is a small medium-sized evergreen tree growing from 10 to 28 m in height. The leaves are flat, dark green, and arranged spirally on the stem.<sup>[2]</sup> In Asia, its distribution stretches from Afghanistan through the Himalayas to the Philippines, and it is widely distributed in Pakistan and India. In India, it grows in its natural habitat in Nanda Devi Biosphere Reserve (NDBR) of Garhwal Himalayas, particularly on the north to north-west slopes.<sup>[3]</sup>

The Himalayan yew, known as *Thuner* in western Himalayas, has high medicinal value and ethnobotanical importance.<sup>[3]</sup> The plant holds an important place in traditional medicine and its products are used by the local populations for treating common infections. It received wide attention recently because its leaves and bark were found to be the prime source of taxol, a potent anticancer drug which has a unique property of preventing the growth of cancerous cells and is used in the treatment of breast and ovarian cancers.<sup>[4]</sup> Taxol was first isolated from the bark of *Taxus brevifolia*,<sup>[5]</sup> and since then, taxol and related bioactive taxoids have been reported from various other species of the genus *Taxus*.<sup>[6,7]</sup> Excellent clinical results with taxol in the treatment of various cancers, particularly in refractory ovarian and breast cancers, have led to a substantial demand for this drug.<sup>[8,9]</sup> The leaves and bark of *T. brevifolia*, *T. wallichiana*, and other *Taxus* species have been

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used for the extraction of taxol. Due to overexploitation, many species are now endangered and on the verge of extinction.<sup>[10]</sup> Moreover, several species are disappearing at an alarming rate mainly at higher altitudes due to over-harvesting, habitat destruction, and abrupt climate change.

Available literature on *T. wallichiana* shows its analgesic, antipyretic, anti-inflammatory, immunomodulatory, antiallergic, anticonvulsant, anticociceptive, antiosteoporotic, antibacterial, antifungal, antiplatelet, and antispasmodic activities and vasorelaxing effect.<sup>[2,11-14]</sup>

## USES IN TRADITIONAL MEDICINE

The Himalayan yew has a remarkable history of its usage in the traditional system of medicine. The indigenous people live in nearby forests and possess substantial amount of traditional wisdom on plant utilization. Himalayan medicinal plants form important constituents of alternative medicinal systems such as Amchi, Ayurveda, Han Chinese, Unani, and other traditional medicine systems that are prevalent in this region. Native populations and the inhabitants of the buffer zone villages of NDBR use these plants and their products in folk medicine for the treatment of common infections. Himalayan yew has been used traditionally for the treatment of high fever and painful inflammatory conditions. It is consumed as decoctions, herbal tea, and juice for treating cold, cough, respiratory infections, indigestion, and epilepsy. As poultice, it is used locally on the infected wounds and burns.<sup>[13,15]</sup> Its bark and leaves are used in steam baths to treat rheumatism, and the paste made from its bark is used to treat fractures and headaches. Extracts from the tree are also used in medicinal hair oils. In Pakistan, decoction of the stem is used in the treatment of tuberculosis.<sup>[16]</sup> The bark and leaves of *T. wallichiana* are used in Unani medicine as a source of the drug Zarnab, which is prescribed as a sedative, aphrodisiac, and as a treatment for bronchitis, asthma, epilepsy, snake bite, and scorpion stings.<sup>[3]</sup> Young shoots of the plant are used in Ayurveda to prepare a tincture for the treatment of headache, giddiness, feeble and falling pulse, coldness of extremities, diarrhea, and severe biliousness.<sup>[1]</sup>

## ANTI-INFLAMMATORY AND ANALGESIC ACTIVITIES

The analgesic and anti-inflammatory properties of the *T. wallichiana* bark extract have been studied.<sup>[12]</sup> Tasumatrol B, 1,13-diacetyl-10-deacetylbaaccatin III (10-DAD), and 4-deacetylbaaccatin III (4-DAB) were isolated from the bark extract of *T. wallichiana* Zucc. The compounds were assessed for anti-inflammatory and analgesic activities using an acetic acid induced writhing model, carrageenan-induced paw edema model, and *in vitro* lipoxygenase inhibitory assay. All the compounds, especially tasumatrol B, showed significant anti-inflammatory activity in carrageenan-induced paw edema model,<sup>[12]</sup> which is used extensively to determine the anti-inflammatory effect of new investigational agents.<sup>[17]</sup> Taxusabietane A, isolated from the bark extract of *T. wallichiana*, was analyzed for *in vivo* and *in vitro* anti-inflammatory activities using

the lipoxygenase inhibitory assay and the carrageenan-induced paw edema model, where taxusabietane A showed significant anti-inflammatory activity.<sup>[11]</sup>

Using the acetic acid induced abdominal writhing model, the analgesic properties of the bark extracts were analyzed. All compounds, particularly tasumatrol B, revealed significant analgesic activity.<sup>[12]</sup> Acetic acid plays a critical role in nociception.<sup>[17]</sup> Involving the prostaglandin and cyclooxygenase biosynthetic pathway, it releases arachidonic acid. Analgesic properties of *T. wallichiana* extract may be due to its inhibitory effects on the biosynthesis of arachidonic acid metabolites.<sup>[12]</sup> The potential of tasumatrol B as a new lead compound for the management of pain and inflammation can be further explored.

## ANTICONVULSANT AND ANTIPYRETIC ACTIVITIES

It was found that the methanol extracts of *T. wallichiana* possess potent anticonvulsant and antipyretic activities.<sup>[2]</sup> The plant extract controlled the pentylenetetrazol-induced convulsions in mice. The plant extract, when administered in doses of 100 mg/kg and 200 mg/kg, significantly inhibited myoclonus and clonus, while inhibition of tonus and hind limb tonic extension were found to be more significant. In the same study, the antipyretic activity of the plant extract was also shown, where in yeast-induced pyrexia model, a 200 mg/kg dose caused a significant inhibition. However, in doses of 50 mg/kg and 100 mg/kg, it caused less significant inhibition. The anticociceptive and antipyretic activities may be attributed to the presence of phenols, polyphenols, tannins, saponins, anthraquinones, alkaloids, steroids, and especially, the diterpenes found in the crude extract of the plant.<sup>[1,7,13]</sup> The anticonvulsant and antipyretic activities of *T. wallichiana* Zucc. support its traditional uses in epilepsy and pyrexia.

## ANTICANCER ACTIVITIES

After the discovery of the anticancer drug taxol (Paclitaxel) from the bark of Pacific yew tree *T. brevifolia*,<sup>[5]</sup> in 1971, lot of work was carried out on the chemical investigation of almost all parts (needles, bark, root, seed, heartwood) of several yew species,<sup>[7,14,18-21]</sup> resulting in the isolation and characterization of 300 taxoids. Systemic studies conducted on the chemical constituents acquired from different parts of *T. wallichiana* revealed several taxoids of different structural types, with five of them being novel molecules.<sup>[22]</sup> Three ligands have been isolated, viz. taxiresinol 1, isotaxiresinol 2, and (–)-secoisolariciresinol 3, from the heartwood of the plant, which possess anticancer activity.<sup>[22]</sup> Among these, taxiresinol 1 showed notable *in vitro* anticancer activity against liver, colon, ovarian, and breast cancer cell lines.<sup>[4,8,9,22]</sup>

Taxol is a highly substituted polyoxygenated cyclic diterpenoid characterized by the taxane ring. It inhibits cell proliferation by promoting the stabilization of microtubules at the G2-M phase of the cell cycle, due to which the depolymerization of microtubules to soluble tubulin is blocked.<sup>[23,24]</sup>

## ANTIBACTERIAL AND ANTIFUNGAL ACTIVITIES

Extracts from various *Taxus* species have been reported to possess antibacterial and antifungal activities. Taxoids isolated from *Taxus cuspidata* var. *nana* have been reported to possess antifungal activity against plant pathogenic fungi.<sup>[25]</sup> Heartwood extract from *Taxus buccata* has potential antibacterial and antifungal activity.<sup>[26]</sup> Bilobetin, a biflavone obtained from the needles of *T. buccata*, has also been reported to possess antifungal activity.<sup>[27]</sup> Methanol extracts of the leaf, bark, and heartwood of *T. wallichiana* were tested against six bacterial and six fungal strains using the hole diffusion and microdilution methods.<sup>[13]</sup> All extracts and fractions from the plant displayed significant antimicrobial effects, and the minimum inhibitory concentration (MIC) values for the bacterial strains ranged from 0.23 to 200 mg/ml and from 0.11 to 200 mg/ml for fungi. Taxol and related bioactive taxoids from *T. wallichiana* may be responsible for the antimicrobial activities. These activities may also be attributed to the presence of phenols, polyphenols, tannins, saponins, anthraquinones, alkaloids, steroids, and especially, the diterpenes found in the plant extract. These families of natural products and phytochemical groups are known to display antimicrobial activities.<sup>[1,7,13]</sup>

## CONCLUSION

The extracts of *T. wallichiana* Zucc. have been found to possess therapeutic potential, and the plant has its important place in traditional medicine. However, traditional knowledge, which passes orally from generation to generation, is on the verge of extinction due to the disruption of cultural set-ups, caused by rapid socio-economic transformation and modernization of society. The diverse biological activities demonstrated by researchers open the door for its potential use in modern medicine. The extracts from various parts of the plant have significant activity against pain, inflammation, fever, fungal and bacterial infections, convulsions, and cancer. Further elaborative studies can lead to development of the safe actives for therapeutic use in modern medicine and will offer better understanding of its mechanism of action.

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