**Taxus wallichiana** Zucc. (Himalayan Yew): insights on its anti-microbial and pharmacological activities

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**Abstract**

**Introduction**

*Taxus wallichiana* Zucc. (Himalayan Yew) has a remarkable history of medicinal uses in contrast to the other yews. In this critical review, we focused our discussion on the analgesic, anti-inflammatory, anti-fungal, anti-bacterial, anti-convulsant, anti-pyretic and anti-cancer activity of *T. wallichiana*.

**Conclusion**

The isolated lignans from *T. wallichiana* display many biological activities that include high activity as analgesic, anti-inflammatory, anti-fungal, anti-bacterial, anti-convulsant, anti-pyretic and anti-cancer agents. Further studies are recommended to identify the mode of action of these lignans, allowing us to understand its possible role in human physiology.

**Introduction**

*Taxus wallichiana* Zucc. (Himalayan Yew) is a small to medium sized evergreen tree, growing 10–20 m tall. In exceptional cases, it can grow up to 28 m tall. Its leaves are flat, dark green, arranged spirally on the stem. Depending on taxonomic treatment, *T. wallichiana* are found to have a wide growth range in Asia, stretching from Afghanistan through the Himalayas to Philippines. It is found growing in Afghanistan, Bhutan, China, India, Indonesia, Malaysia, Myanmar, Nepal, Pakistan, Philippines and Vietnam.

This plant is used traditionally for the treatment of high fever and painful inflammatory conditions. The leaves of this plant are used to make herbal tea for indigestion and epilepsy. Previously published literatures on *T. wallichiana* have reported immunomodulatory, anti-bacterial, anti-fungal, analgesic, anti-pyretic and anti-convulsant activities. In India, extracts from its bark and leaves are used in Unani medicine as a source of the drug Zarnab, prescribed as a sedative, aphrodisiac and as a treatment for bronchitis, asthma, epilepsy, snake bites and scorpion stings. In Ayurvedic medicine, young shoots are used to prepare a medicinal tincture for the treatment of headache, diarrhoea and biliousness. The leaves are also used for the treatment of hysteria, epilepsy and nervousness. Its bark and leaves are considered to possess anti-fertility properties. It has also been used in steam baths to treat rheumatism. A paste made from the bark is used to treat fractures and headaches. The inhabitants of the buffer zone villages of the Nanda Devi Biosphere Reserve in India collect the *Taxus* bark and leaves, mainly for traditional teas and for curing colds and coughs, a practice also commonly seen in other rural areas. Extracts from this tree are also used in medicinal hair oils. In Pakistan, a decoction of the bark extract of *T. wallichiana* is an important medicinal property of *T. wallichiana*.

**Discussion**

**Analgiesic and anti-inflammatory activities**

Tasumatrol B, 1,13-diacetyl-10-deacylbaccatin III and 4-deacetylbaccatin III were isolated from the bark extract of *T. wallichiana*. All the compounds were assessed for analgesic and anti-inflammatory activities. All the compounds, especially tasumatro B revealed significant analgesic activity. In this case, the acetic acid induced abdominal writhing model, which is well-known as a visceral pain model, was used. The acetic acid is responsible for releasing arachidonic acid, involving the prostaglandin and cyclooxygenase biosynthetic pathway. Thus, acetic acid plays a critical role in nociception. High doses of *T. wallichiana* were shown to produce significant analgesia, and this may be correlated to their inhibitory effect on the biosynthesis of arachidonic acid metabolites.

Similarly, all of the test compounds, particularly tasumatro B, showed significant anti-inflammatory activity in carrageenan induced models. Carrageenan induced paw oedema, being an *in vivo* investigational model for acute inflammation, has been extensively used to determine the anti-inflammatory effect of new investigational agents. Taxusabietane A is another compound isolated from the bark extract of *T. wallichiana*. It was analysed for its anti-inflammatory activity using the lipoxigenase inhibition assay and the carrageenan induced paw oedema model. Results revealed considerable lipoxigenase inhibitory activity with an IC₅₀ value of 57 ± 0.31 μM. A standard

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Anti-fungal and anti-bacterial activities

Literature survey has revealed that no significant work has been done on the anti-bacterial and anti-fungal activities of the *T. wallichiana*. However, Nisar et al. tested methanol extracts of the leaf, bark and heart-wood of *T. wallichiana* against six bacterial and six fungal strains using the hole diffusion and macro-dilution methods. All extracts and fractions displayed significant anti-microbial effects. Taxol and related bioactive taxoids from *T. wallichiana* may be responsible for the observed anti-microbial activities. These activities may also be attributed to the presence of alkaloids, phenols, polyphenols, saponins, tannins, anthraquinones, steroids, and especially diterpenes, found in the extract. These families of natural products and phytochemical groups are known to display anti-microbial activities.

Anti-convulsant and anti-pyretic activities

Nisar et al. carried out a study to establish the scientific basis of *T. wallichiana* used as an anti-convulsant and anti-convulsant drug. They found that the plant extract controlled pentylenetetrazol-induced convulsions in mice. They showed that 100 mg/kg and 200 mg/kg intraperitoneal doses of the extract significantly (*p < 0.05*) inhibited mioclous and clonus while inhibition of tonus and hind limb tonic extension was found to be much more significant (*p < 0.01*)

Furthermore, the anti-convulsant effects of *T. wallichiana* were compared with that produced by the GABA<sub>A</sub> agonist diazepam, a potent anti-epileptic drug, highly effective to prevent convulsions induced by pentylenetetrazole. The benzodiazepine site in the GABA<sub>A</sub> receptor and T-type Ca<sup>2+</sup> currents could be targets for future studies to learn more about the mechanisms of action of the *T. wallichiana* extract and/or its constituents.

In the case of the yeast-induced pyrexia model, a 200-mg/kg dose showed very significant (*p < 0.01*) inhibition, while 50- and 100-mg/kg doses caused a less significant (*p < 0.05*) inhibition.

Overall, the anti-nociceptive and anti-pyretic activities may be attributed to the presence of alkaloids, phenols, polyphenols, saponins, tannins, anthraquinones, steroids, and especially diterpenes (i.e. taxoids), found in the crude extract.

Anti-cancer activities

Chattopadhyay et al. carried out systematic studies on the chemical constituents acquired from different parts of *T. wallichiana*. They isolated and identified several taxoids of different structural types with five of them being new molecules. They isolated three lignans from the heart-wood of the plant which were shown to have anti-cancer activity. These three lignans have been characterised as taxiresinol 1, isotaxiresinol 2 and (-)-secoisolariciresinol 3 on the basis of their spectral characteristics. Amongst these compounds, the absolute configuration of taxiresinol 1 showed notable in vitro anti-cancer activity against colon, liver, ovarian and breast cancer cell lines.

Conclusion

Various biological activities of the isolated lignans from *T. wallichiana* have been summarised in this critical review. These lignans exerted diverse biological activities against tested methods. They were found to show high activity especially as analgesic, anti-inflammatory, anti-fungal, anti-bacterial, anti-convulsant, anti-pyretic and anti-cancer agents. These lignans should be further evaluated to develop safe agents which can be introduced in modern therapy. Further studies should be conducted to reveal the mode of action of these lignans which might be helpful in understanding their possible role in human physiology.

References

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