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Review Article

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TAXUS BACCATA (*STHAUNEYA*): POTENTIAL ANTICANCEROUS MEDICINAL PLANT – A REVIEW

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ABSTRACT

Cancer is a serious public health concern all over the world due to a lack of traditional treatments and the harsh side effects of chemotherapy. It is the second greatest cause of death in the world, following heart disorders. Medicinal plants have been used to treat a wide range of ailments since ancient times. Natural products are critical in the fight against cancer and provide a valuable resource for the creation and testing of new therapeutic treatments. This review explains an overview of potential therapeutic effect of *Taxus baccata* (*Sthauneya*) as anticancer plants. Peclitaxel, an active chemical identified in taxus sp., is important for its capacity to cure various tumors. PTX and its variants are effective against a variety of cancer cell lines.

KEYWORDS: *Taxus baccata*, *Sthauneya*, taxol, peclitaxol, anticancerous agent.

INTRODUCTION

Taxus × *media* (*Taxus* × *media* Rehder), a member of the genus *Taxus* in the family Taxaceae, is a plant that combines medicinal, timber, and ornamental values, thus possessing significant economic and research importance.[1] As a species within the Taxus genus, it plays a crucial role in the ecosystem and is highly valued in the field of medicine due to its rich bioactive compounds.[2] Many advancements have been made in developing anticancer medications due to studies on the molecular pathways involved in cancer growth. However, despite these efforts, using chemically made medications has not significantly improved overall survival rates. Treating cancer remains a challenging task with limited success. Available treatment choices comprise surgery, radiation therapy, and systemic chemotherapy. In the chemotherapy drug category, medications like methotrexate (antimetabolites), cisplatin and doxorubicin (DNA-interactive drugs), taxanes (anti-tubulin) are most widely used in addition to other hormones, and molecular targeting drugs.[3]

ORIGIN AND GEOGRAPHICAL LOCATION

The genus *Taxus* (Taxaceae) contains seven to nine species[4] among which, *Taxus baccata*, *T. brevifolia*, *T. canadensis*, *T. cuspidata* and *T. floridana* are the most well-known species. *T. baccata* Hook. F. syn. *T. wallichiana* Zucc is found in Europe, North Africa, the Caucasus, Iran and temperate areas of the Indian sub-continent. Popularly known as Himalayan yew, it is distributed from Pakistan to southwest China, Nepal and Bhutan, mainly at elevations of 1800–3300 m a.s.l. In Indian Himalaya, it is locally called '*Rakhal*' or '*Thuner*', and is the only species of the genus in Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Meghalaya, Nagaland and Manipur, mainly associated with oak (*kharshu*) and silver fir species, rarely with spruce, deodar cedar and oak (*mohru*) in the western Himalaya, and in Eastern Himalaya it is mostly associated with silver fir, hemlock-spruce and rhododendron. This evergreen tree flowers during March–April and seeds ripen from September to November. It can tolerate frost, drought and strong winds, and usually grows on limestone-derived moist soil.[5]

Yew is a valuable medicinal plant, chiefly for its Taxine and DAB (10-deacetyl baccatin III) content. Initially, the tree was exploited for bark but later demand shifted to leaves, and it is a source of taxine, a precursor to the drug Taxol, used in preparation of Paclitaxel for treatment of ovarian cancer. Oncologists working with taxol regard it as one of the best anticancer agents. According to the Wealth of India.[5] Taxol was first

extracted from bark of *T. brevifolia*, and anti-cancer properties were first reported in 1964.[7]

BOTANICAL DISCRIPTION

- A small or medium sized evergreen tree, stem fluted, branches horizontal, wide-spreading, not whorled.
- Leaves 2.5-3.8 cm. long, linear, flattened, distichous, acute, narrowed into a short petiole which is decurrent along the twig, dark green and shining above, pale yellowish brown or rusty red below.
- Flowers usually dioecious. Male flowers in catkins which are sub globose and solitary in the leaf axils; stamens about 10, pollen sacs 5-9, globose, arranged around the filament beneath the peltate tip of the stamens. Female flowers solitary, axillary, resembling leaf- buds, each consisting of a few imbricate scales round a single erect ovule, which is surrounded at the base by a membranous cup-shaped disk.
- In fruit the disk enlarges, becomes succulent and bright red, about 7.5 mm. long, and surrounds the olive-green seed of which only the tip is exposed. Testa woody; embryo with 6-7 cotyledons.[8]

Fig. 1. Flower

Fig. 2. Fruits

Fig. 3. Leaves

Fig. 4. Bark

Fig. 5. Tree

Source of fig. 1., fig. 2., fig. 3., fig. 4., fig. 5. from https://identify.plantnet.org/k-world-flora/species/Taxus%20baccata%20L./data

DESCRIPTION AS PER AYURVEDIC TEXTS

Taxus baccata explained in the controversy of *Talish patra*, it is now explained as Sthounayak[9].

स्थौणेयक के गुण

स्थौणेयं कफवातघ्नं सुगन्धि कटुतिक्तकम्।
पित्तप्रकोपशमनं बलपुष्टिविवर्द्धनम् ।।
(राज निघण्टु चंदनादि वर्ग/130)[10]

स्थौणेयकं कटु स्वादु तिक्तं स्निग्धं त्रिदोषनुत।
मेधा शुक्रकरं रूच्यं रक्षोघ्नं ज्वरजन्तुजीत्।
हन्ति कुष्ठास्रतृडदाहदौर्गन्ध्य तिलकालकान्।
(भावप्रकाश निघण्टु कर्पूरादि वर्ग/110-111)[11]

In Charak Samhita

Charak Chikitsa 3/267	*Agruadi Taila*[12]
Charak Chikitsa 23/54	*Mritsanjivan Agad*[13]
Charak Chikitsa 28/154	*Bala Taila*[14]
Charak Kalpa 1/23	*Madanphal Utkarika Modak Yog*[15]

In Sushruta Samhita

Elaadi gana of Sushruta Samhita Sutra 38/24.[16]

According to Ayurvedic Pharmacopoeia of India[17]

SYNONYMS

Sanskrit: Sukapuspa, Vikarna
Beng.: Birmi, Bhirmie, Talish Patra, Bhada Getela
Eng.: Himalayan Yew
Guj.: Gethela Barmi

Hindi: Thuner, Talispatra Bhed
Kan.: Sthauneyak
Mal.: Thuriangam, Tuniyankam
Mar.: Sthauney Barmi
Ori.: Talisabhed, Chalisa Patra
Punj.: Birmi
Tam.: Talispatri-Bhedam
Tel.: Taleesa Patri Bhedamu
Urdu.: Birmi, Zarnab

DESCRIPTION

a) Macroscopic: Drug occurs as whole or broken leaf pieces, entire leaf flattened, linear with recurved margins, 1.3-4.0 cm long and 0.1-0.3 cm wide, tip sharp pointed and prickly. entire, thick, brown above, but paler below, petiole, very short: odour, pleasant, taste. acrid, bitter and disagreeable.

b) Microscopic

Leaf

Lamina shows dorsiventral structure, margin slightly turned downward, upper epidermis single layered covered with thick, striated cuticle, lower epidermis single layered with papillate projection, sunken stomata present only on lower surface, overhung by subsidiary cells, palisade two layered, spongy parenchyma 3-5 layered, thin-walled, oval or irregular in shape, containing reddish-brown contents, vascular bundle single, present in the midrib within an endodermis.

Powder- Brown; Shows fragments of reddish-brown spongy parenchyma cells and very rarely xylem tracheid, polygonal epidermal cells with striated cuticle and a few sunken stomata in surface view.

IDENTITY, PURITY AND STRENGTH

Foreign matter-Not more than 2 per cent, Appendix 2.2.2.

Total ash-Not more than 6 per cent, Appendix 2.2.3.

Acid-insoluble ash-Not more than 1.5 per cent, Appendix 2.2.4

Alcohol-soluble extractive-Not less than 10 per cent, Appendix 2.2.6.

Water-soluble extractive-Not less than 16 per cent, Appendix 2.27

CONSTITUENTS- Alkaloids -Taxine, Ephedrine, Glycoside, Tannins, Resins, Reducing Sugars and Formic Acid.

PROPERTIES AND ACTION

Rasa: Katu, Tikta, Madhura
Guna: Snigdha, Guru
Virya: Sita
Vipaka: Madhura
Karma: Medhya, Sukravardhaka, Kaphahara, Vatahara, Pittasämaka, Jantughna, Varna Prasadaria, Lomasanjanana

IMPORTANT FORMULATIONS: Mahānārāyana Taila, Balá Taila

THERAPEUTIC USES-Rakta-Vikāra, Trsná, Tila Kalaka, Daha, Kustha, Krmi Roga, Pidika, ***Arbuda (Karkata)***

DOSE-1-3 g. of the drug in powder form.

ANTICANCER ACTIVITY

Paclitaxel, the principal antitumor component of *Taxus* × *media*, is a diterpenoid compound. Due to its concentration in the bark and leaves, it has been extensively harvested[18] and used in various traditional medical systems to treat many diseases.[19,20] Paclitaxel inhibits tumor cell mitosis and proliferation by promoting microtubule stabilization. This mechanism of action has led to its widespread use in the treatment of various types of cancer, including ovarian, breast, Kaposi's sarcoma, and lung cancer.[21]

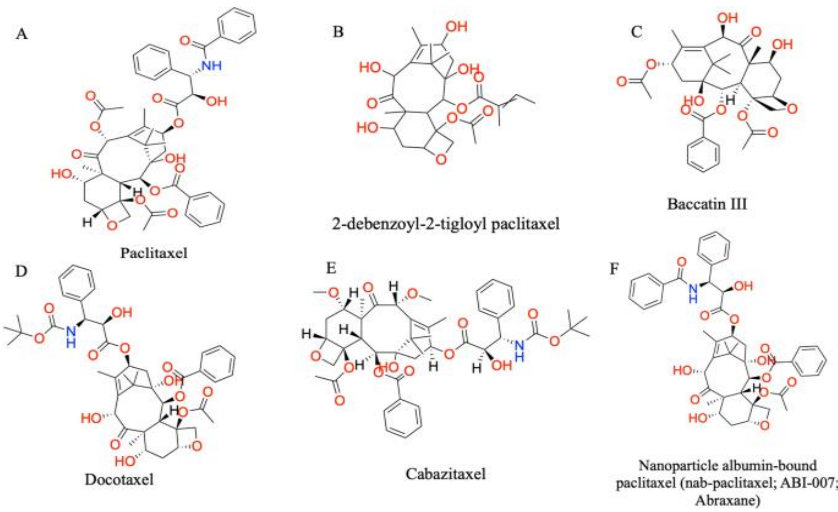

Fig. 6: From: Paclitaxel and its semi-synthetic derivatives: comprehensive insights into chemical structure, mechanisms of action, and anticancer properties.

Chemical structure of paclitaxel and its derivatives. **A** Paclitaxel, **B** 2-debenzoyl-2-trigloyl paclitaxel, **C** baccatin III, **D** docetaxel, **E** cabazitaxel, and **F** Abraxane

MECHANISM OF ACTION

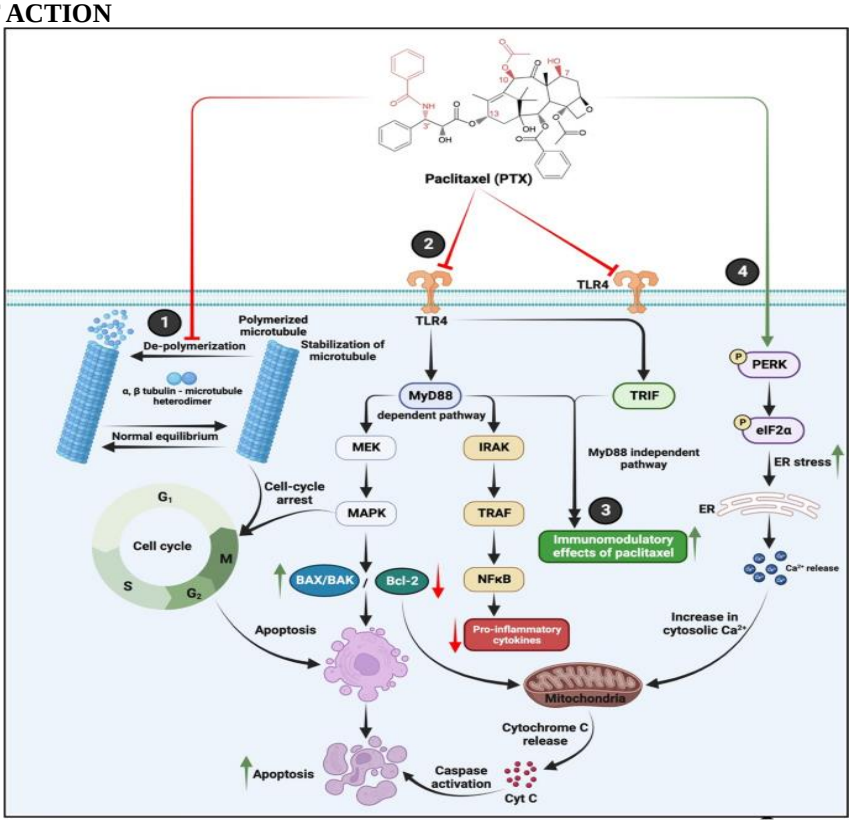

Fig. 7: From: Paclitaxel and its semi-synthetic derivatives: comprehensive insights into chemical structure, mechanisms of action, and anticancer properties.

Mechanism of anticancer action of Paclitaxel (PTX): PTX intervention leads to (1) stabilization of microtubule, cell arrest, and subsequent apoptosis, (2) inhibition of the TLR4 signaling pathway, (3) increase in the immunomodulatory effects of the drug and (4) activates ER stress-mediated cell death in different cancers. BAK: Bcl-2 homologous antagonist/killer; BAX: Bcl-2 associated X protein; Bcl-2: B cell lymphoma 2; Cyt C: cytochrome C; eIF2α: eukaryoic translation initiation factor 2 alpha; ER: endoplasmic reticulum; IRAK: interleukin 1 receptor-associated kinase; MAPK: mitogen-activated protein kinase; MEK: MAPK/extracellular signal-regulated (ERK) kinase; MyD88: myeloid differentiation primary response protein 88; NFκB: nuclear factor light chain enhancer of kappa; PERK: PRKR-like endoplasmic reticulum kinase; PTX: paclitaxel; TLR4: toll-like receptor 4; TRAF: tumor necrosis factor (TNF) receptor-associated factor; TRIF: TIR domain-containing adaptor protein. created Biorender.com

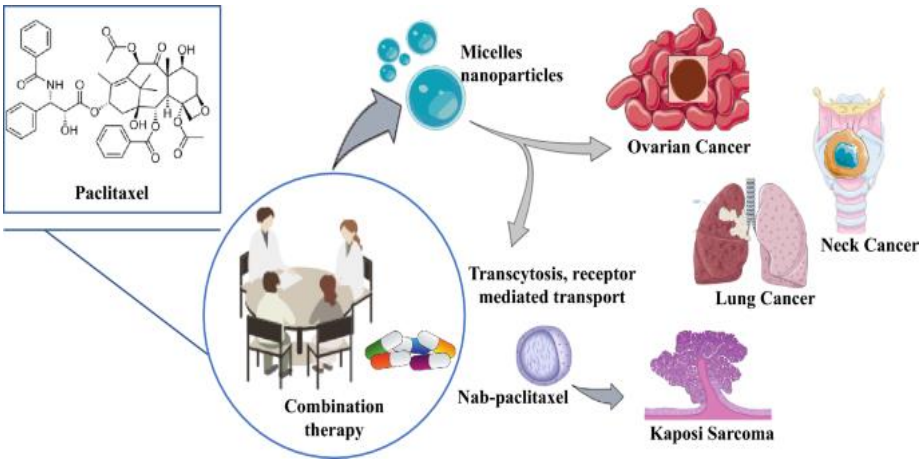

Fig. 8: From: Paclitaxel and its semi-synthetic derivatives: comprehensive insights into chemical structure, mechanisms of action, and anticancer properties.

Paclitaxel vital role in several cancer types.

CONCLUSION

Taxus baccata is commonly utilized as an anticancer plant because it contains *taxol*, which acts as an anticancer agent. It is described in ayurvedic literature as *Sthauneya*, which is disputed by *Talish patra*, but subsequently *Vaidya Bapalal* interpreted it as *Sthauneya*, which is similar to *Taxus baccata*. It is a high-potential plant for usage as an anticancer agent. Researchers have now moved their focus to organic molecules that work as anticancer drugs. Further research is needed to investigate the potential effect of *Taxus baccata* as an anticancer medication.

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