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Taxus wallichiana zucc. (Himalayan Yew) in Antimicrobial Perspective

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Introduction

Discovery of penicillin, followed by other antibiotics such as streptomycin, aureomycin and chloromycetin, supported the world of medicine in treating a range of infectious diseases. However, considerable reports on the antibiotic resistance phenomenon and development of the side effects due to consumption of microbe based antibiotics indicated towards the need of alternate sources for combating the infectious diseases. In this perspective, plant based antimicrobials (derived from medicinal plants, in particular) are increasingly receiving attention for harnessing their potential in production of antimicrobial substances as safer source of antibiotics. Crude extracts and essential oils of medicinal plants possess bioactive compounds, often with antimicrobial and antioxidant properties. Importance of isolation and structure identification of these bioactive compounds (also referred as principal or active ingredients) in medicine formulation is a topic of great interest in advancement of global research. On the basis of active ingredients, the plant derived antimicrobials are categorized into three major classes- alkaloids, phenolics and terpenes.

A small fraction of the known plant species on earth (estimated at 250,000-500,000) has been investigated for their antimicrobial potential; up to 1-10% of these plants are used by humans [1]. The examples of the medicinal plants that received greater attention for their antimicrobial potential are species of *Albizia, Calotropis, Cinnamomum, Cupressus, Dature, Juniperus, Ocimum, Origanum, Rumex, Tabebuia and Zanthoxylum*. The Himalayan ecosystem, that harbors plethora of medicinal plants, is also receiving attention for their investigation with reference to their antimicrobial potential. These include the species of *Aconitum, Artemesia, Astilbe, Bacopa, Bergenia, Eupatorium, Hedychium, Hippophae, Picrorhiza*, etc. [2].

Clinical microbiologists have been interested in the topic of plant extracts with a view to formulate the associated bioactive compounds in antimicrobial drugs that are prescribed by the physicians. Asian countries represent one of the most important centers of knowledge on biodiversity of medicinal plants used in treatment of various ailments. The well known traditional Chinese, Indian Ayurveda and Arabic Unani systems of medicine have been based on the use of various herbs, shrubs and trees. In view of the rich biodiversity and extensive knowledge and literature, prioritization of medicinal plants for their cultivation and drug formulation has been realized [2]. On this line, various species of *Taxus* have been recognized as one of the most important discovery in human chemotherapy for the treatment of several forms of cancers. While most of the investigations on *Taxus* have been based on its propagation and anti-cancerous properties, other equally important aspects of this evergreen gymnosperm, such as its antimicrobial potential, still needs advance and focused research efforts. This short communication gives a general account of Himalayan yew highlighting the probability of harnessing its antimicrobial potential.

Taxus wallichiana (Zucc.) Pilg. (Synonym: *Taxus baccata* L. ssp. *wallichiana* (Zucc.) Pilg.; English name: Himalayan Yew; Hindi name: Thuner), mentioned in IUCN red list, is recognized as a medicinally important evergreen tree that grows under the temperate locations in Himalaya. Three species of yews of medicinal importance namely *Taxus contorta, T. mairei and T. wallichiana* have been reported for their commercial exploitation from the Hindu Kush- Himalaya [3]. *Taxus* is medium sized, slow growing and dioecious gymnosperm that reaches nearly 6m in height (Figure 1). In the Indian subcontinent, the species grows in the northern hemisphere with its distribution in the hills of

the northern Jammu & Kashmir, Himachal Pradesh, Uttarakhand and the states in northeast namely Meghalaya, Nagaland and Manipur, at an altitude range of 1800-3300m. The species has received considerable attention on account of its existing exploitation for the extraction of the drug (taxol) and also the removal of old forests [4-6]. It is found in shady places, either in patches or associated with oak, silver fir, spruce and deodar forests. Its regeneration in nature is through seed only which is reported very poor (around 8%) and the germination does not occur until the second year [7]. The prevalence of anti-germination factors, probably of microbial origin, has also been reported from rhizosphere of *T. baccata* ssp. *wallichiana* [8]. Taxonomically, it is classified as: Kingdom: Planate; Phylum: Tracheophyta; Class: Pinopsida; Order: Pinales; Family: Taxaceae [9,10].

Figure 1: (A) *Taxus wallichiana* tree growing at Jageswar (Dist. Almora, Uttarakhand, India). (B) Exhibiting the current year's needles. (C) Emerging above the previous year ones.

Chemical Constituents and the Therapeutic Uses

The diterpenoid alkaloid, taxol® (paclitaxel), was first isolated from the bark of *Taxus brevifolia Nutt.* [11]. subsequently, taxol and taxoid derivatives were reported from foliage and bark of several other species of Taxus including *Taxus wallichiana*. *T. wallichiana* has been known for its medicinal properties in the traditional systems of Unani and Ayurvedic medicine. Now, the species is well recognized as source of anti-cancerous drug taxol® for treating various form of cancers. The needles, stem and bark of *T. wallichiana* have been reported to contain taxol, baccatin 111, and 10-deacetylbaccatin 111, a precursor for taxol synthesis. Taxoid derivatives have been reported from various plant parts of *T. wallichiana. T. wallichiana* is also known for its various ethno-medicinal uses. Leaf paste is used for the treatment of asthma and bronchial disorders. Tea, made out of the stem bark of Himalayan yew, has been popular in Himalayan tribal communities for curing cold, cough and hypertension. The species is also known for antioxidant activity [12]. Lignan derivatives, isolated from the heart wood of *T. baccata* have been reported for cytotoxicity against the Oncology Cell Line Panel and for the antimicrobial activities as well [13]. Lignans, isolated from eight *Taxus* species, have been studied for their biological activities [14].

Diversity of taxol®-producing endophytic fungi has been studied from *Taxus x media* [15]. Isolation of taxol® from the endophytic fungus (*Aspergillus candidus*) has been reported from the inner bark of *Taxus x media* [16]. The endophytic fungi isolated from the bark of *T. baccata* has also been reported for anticancer and antioxidant activities [17].

Antimicrobial Potential

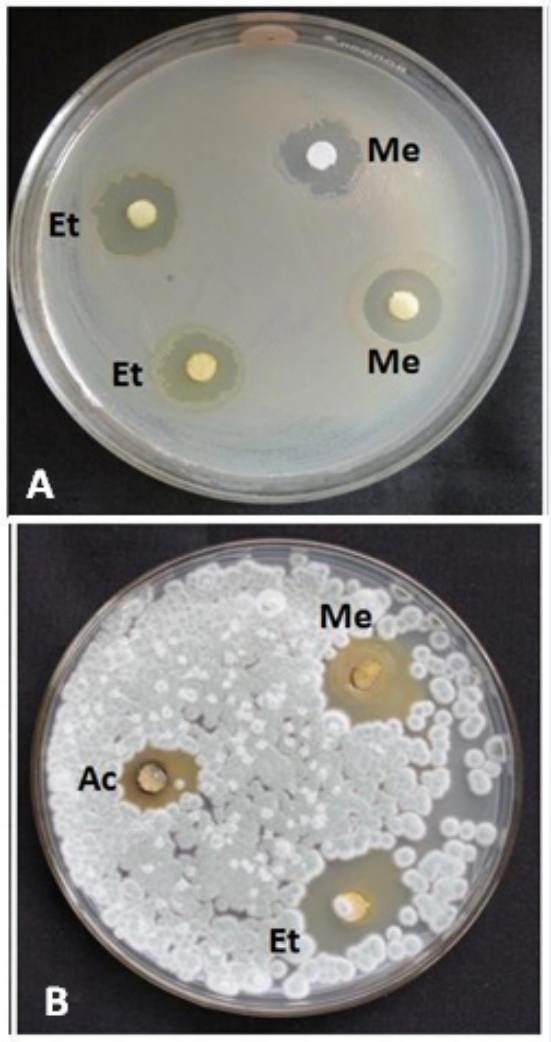

Figure 2: Antimicrobial activity of Taxus wallichiana leaf extract on agar plates:(A) Antibacterial and (B) Antifungal (Et- ethanolic extract, Me- methanolic ectract, and Ac acetone extract).

The plant extracts, from medicinal plants in particular, have been studied for harnessing their potential in treating a range of diseases giving limited attention to their antimicrobial properties. The species of *Taxus* has been an example of this

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[12,13,18,19] that needs advancement in research to explore its antimicrobial metabolites. In an initiative, taken under National Mission on Himalayan Studies, the species (*Taxus wallichiana*) is being investigated with respect to its antimicrobial potential in various plant parts namely needles, bark, and stem. In qualitative estimations, the crude extracts of the plant parts exhibited inhibitory effect on bacteria (Gram +ve and Gram -ve) and fungi (Figure 2). It was further supported by the preliminary results on quantitative estimations that were carried out with respect to the minimum inhibitory concentration. The initial observations extend the opportunity to screen the bioactive constituents with respect to their antimicrobial activity, mainly antibacterial and antifungal.

Challenges and Future Perspective

Application of traditional knowledge on medicinal plants is growing as a vast multidisciplinary research area. Investigations on 'antimicrobial medicinal plants' is emerging as one of the front line research areas in phytomedicine. One of the major challenges as well as the prerequisite in this area, particularly in case of the rare, endangered and threatened medicinal plants, will be the development of efficient propagation packages for procurement of sufficient amount of the required plant material. Development of propagation packages including harvest as well as the post harvest techniques and involving conventional as well as the microbiological and biotechnological tools will support this challenging task. In view of the exploitation of the species *T. walliciana* from the Indian Himalayan region, several studies on its germination and rhizosphere associates have been conduced [7,8,20,21]. Besides, various agro-techniques have been applied for the propagation and conservation of this species [22-24].

Increasing publications on the screenings of potential antimicrobial plants from the microbiological laboratories worldwide is an indicative of the interest of the scientific community in this research area of bio-prospection. *Gingko biolba* (often referred as the living fossil) is an example in recent years that has been studied for its antimicrobial potential [25] along with the development of a bio-formulation based on an endophytic bacterium [26]. The bacterium, identified as a species of *Pseudomonas,* was isolated from the cortical roots of *G. biloba* and is useful as inoculants in propagation and conservation of the species. This strategy needs replication with respect to other plant species, such as *T. wallichiana.*

Standardization of the appropriate high-throughput screening bioassays and scale-up of bioactive compounds are other areas where the attention of the researchers is required. Further advances and clear distinctions will be necessary amongst the antimicrobial metabolites with classified activities such as antibacterial, antifungal or antiviral. Bio-prospection of endophytic microorganisms from the species of *Taxus,* with respect to their anti-cancerous as well as antimicrobial properties, will certainly be a promising area of advance research. The more recent developments in genomics, proteomics, and metabolomics will be applicable in distinguishing the synergistic efficacy of the plant based secondary metabolites involving the associated mechanisms. The research area has a great potential for generating employment and income at different levels, from the planters to the researchers and to the industrialists.

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References

1. Savoia D (2012) Plant-derived antimicrobial compounds: alternative to antibiotics. Future Microbiol 7(8): 979-990.
2. Pandey A, Agnihotri V (2015) Antimicrobials from medicinal plant and research initiative, challenges, and the future prospects. In: Gupta VK, Tuohy MG, O'Donovan A, Lohani M (Eds.), Biotechnology of Bioactive Compounds: Sources and Applications in Food and Pharmaceuticals. John Wiley & Sons Ltd., USA, pp. 123-150.
3. Poudel RC, Gao L, Möller M, Baral SR, Uprety Y, et al. (2013) Yews (Taxus) along the Hindu Kush-Himalayan region: Exploring the ethno pharmacological relevance among communities of Mongol and Caucasian origins. J Ethnopharmacol 147(1): 190-203.
4. Samant SS, Dhar U, Palni LMS (1998) Medicinal plants of Indian Himalaya, diversity, distribution and potential values. Gyanodaya Prakashan Nainital, India.
5. Nadeem M, Rikhari HC, Kumar A, Palni LMS, Nandi SK (2002) Taxol content in the bark of Himalayan Yew in relation to tree age and sex. Phytochem 60(6): 627-631.
6. Singh H (2007) Himalayan Yew (Taxus wallichiana Zucc.): A multipurpose rare gymnosperm in India. Ind Forester 133(5): 690-696.
7. Anonymous (1976) Wealth of India. Vol X Publication and Information Directorate CSIR India.
8. Pandey A, Nadeem M, Palni LMS (2002) Improvement in seed germination of Himalayan yew through simple soil treatments. Ind J Forestry 25(2): 109-113.
9. The IUCN Red List of Threatened Species™. IUCN 2008: T46171879A9730085.
10. Govaerts R (1843) Taxus wallichiana zucc, Abh. Math-Phys Cl Königl Bayer Akad Wiss 3: 803.
11. Wani MC, Taylor HL, Wall ME, Coggon P, McPhail AT (1971) Plant anti-tumor agents VI. The isolation and structure of taxol, a novel anti-leukemic and antitumor agent from Taxus brevifolia. J Am Chem Soc 93(9): 2325-2327.
12. Juyal D, Thawani V, Thaledi S, Joshi M (2014) Ethno medical properties of Taxus wallichiana Zucc. (Himalayan Yew). J Tradit Complement Med 4(3): 159-161.
13. Erdemoglu N, Sener B, Choudhary MI (2004) Bioactivity of lignans from Taxus baccata. Z Naturforsch 59(7-8): 494-498.
14. Topcu G, Demirkiran O (2007) Lignans from Taxus species. Topics in Heterocyclic Chemistry 11: 103-114.
15. Xiong Z, Yang Y, Zhao N, Wang Y (2013) Diversity of endophytic fungi and screening of fungal paclitaxel producer from Anglojap yew, Taxus x media. BMC Microbiol 13:71.

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16. Zhang P, Zhou P, Yu L (2009) An endophytic taxol-producing fungus from Taxus x media, Aspergillus candidus MD3. FEMS Microbiol Lett 293(2): 155-159.

17. Vasundhara M, Baranwal M, Sivaramaiah N, Kumar A (2017) Isolation and characterization of trichalasin-producing endophytic fungus from Taxus baccata. Ann Microbiol 67(3): 255-261.

18. Krauze-Baranowska M, Wiwart M (2003) Antifungal activity of biflavones from Taxus baccata and Ginkgo biloba. Zeitschrift Naturforsch 58(1-2): 65-69.

19. Nisar M, Khan I, Ahmad B, Ali I, Ahmad W, et al. (2008) Antifungal and antibacterial activities of Taxus wallichiana Zucc. J Enzyme Inhib Med Chem 23(2): 256-260.

20. Purohit A, Maikhuri RK, Rao KS, Nautiyal S (2001) Impact of bark removal on survival of Taxus baccata L. (Himalayan yew) in Nanda Devi biosphere reserve, Garhwal Himalaya, India. Curr Sci 81: 586-590.

21. Chaurasia B, Pandey A, Palni LMS (2005) Occurrence of arbuscular mycorrhizae in the rhizosphere of Himalayan Yew (Taxus baccata L. subsp. wallichiana (Zucc.) Pilger)-A Case Study. In: GK Podila and AK Varma (Eds.), Basic research and applications of Mycorrhizae. IK International Pvt. Ltd, New Delhi, India, pp. 26-35.

22. Nandi SK, Rikhari HC, Nadeem M, Palni LM (1997) Clonal propagation of Taxus baccata Linn. Himalayan asset under threat. Physiol Mol Biol Plants 3: 15-24.

23. Kishor K, Upreti BM, Pangtey YPS, Tewari A, Tewari LM (2015) Propagation and conservation of Himalayan Yew (Taxus baccata L.) through air layering: A simple method of clonal propagation. Ann Plant Sci 4(4): 1064-1067.

24. Aslam M, Raina PA, Rafiq RU, Siddiqi TO, Reshi ZA (2017) Adventitious root formation in branch cuttings of Taxus wallichiana Zucc. (Himalayan yew): A clonal approach to conserve the scarce resource. Curr Bot 8: 127-135.

25. Sati P, Pandey A, Palni LMS (2012) Antimicrobial potential of leaf extracts of Ginkgo biloba L., growing in Uttarakhand, India. Nat Acad Sci Lett 35: 201-206.

26. Pandey A, Sati P, Malviya MK, Singh S, Kumar A (2014) Use of endophytic bacterium (Pseudomonas sp., MTCC9476) in propagation and conservation of Ginkgo biloba L.: A living fossil. Curr Sci 106(8): 1066-1067.

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