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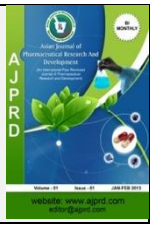

Open Access **Review Article**

A Review on Phytochemical Pharmacological and Biological Activities of Thuja Occidentalis

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A B S T R A C T

Thuja occidentalis plant of Cupressaceae family originated in Eastern North America and is now planted as an ornamental tree in Europe and Brazil, where it is known as the "tree of life" or "white cedar." It's often used to treat liver problems, enuresis, amenorrhea, bullous bronchitis, psoriasis, cystitis, uterine carcinomas, diarrhoea, and rheumatism in traditional medicine. Due to the presence of essential oil, coumarins, flavonoids, tannins, and proanthocyanins, the chemical ingredients of T. occidentalis have piqued researchers' curiosity for decades. Antioxidant, anti-inflammatory, antibacterial, antifungal, anticancer, antiviral, gastrointestinal tract protective action, radioprotection, antipyretic, and lipid metabolism regulating activity are all examples of pharmacology. As a result, the current study is a compilation of all essential material for T. occidentalis, including phytochemical, biological and a detailed examination of their pharmacological properties.The current review represents a synthesis of all relevant information for Thuja occidentalis, including phytochemical, biologicaland a thorough analysis of their pharmacological activities, in order to promote all of the biological activities demonstrated thus far, rather than focusing on a single biological activity.

Keywords: Thuja occidentalis, thujone, pharmacological, biological activities

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INTRODUCTION

The application of diverse complementary treatments is becoming a more popular therapeutic option. The use of plants to cure various diseases plays an important role in this area [1–3]. Even though it is not legally recognised in many countries, folk medicine is extensively utilised across the world [4]. Plants and plant extracts are used by over 80% of the people in Africa and Asia to cure various diseases [5]. The basic herbs offer a solution with no side effects and effective treatments, and the greatest part is that anybody of any age may utilise herbal medicine [6].Secondary metabolites such as steroids, phenolic compounds, flavonoids, alkaloids, and other chemicals can be produced by herbal plants. These secondary metabolites are used to treat a variety of diseases [7]. Natural goods and traditional therapies are quite valuable. Modern medicine will not be the exclusive remedy to today's diseases. As a result, humans favourably discern "return to nature" and converse with it in the same way as plant products are used in medications [8]. Herbal medicines are becoming increasingly popular all over the world for a variety of reasons: They have long-term therapeutic benefits and are known for their efficacy, safety, and low side effects [9,10].Ethnopharmacological research are now promoted across the world as a means of identifying species that contain compounds or beneficial products that may be exploited in the pharmaceutical, nutritional, and cosmetic industries [11,12].

Thuja occidentalis, sometimes known as Arbor vitae or white cedar, is a native of eastern North America and a popular decorative tree in Europe [13]. Native Indians in Canada discovered the herb as a medicine during a 16th century voyage, and it was proven to be useful in the treatment of scurvy weakness [14]. Thuja occidentalis has been used in traditional medicine to treat bronchial catarrh, enuresis, cystitis, psoriasis, psoriasis, uterine carcinomas, amenorrhea, and rheumatism [15–18].It is now mostly used as a mother tincture or dilution in homoeopathy [19,20]. This

medicinal plant is also used as evidence-based phytotherapy for acute and chronic infections of the upper respiratory tract [21,22], and as an adjuvant to antibiotics in severe bacterial infections such as bronchitis, angina, pharyngitis, otitis media, and sinusitis [23,24] when combined with other immunomodulating plants like Echinacea purpurea, Echinacea pallida, and Baptisia tinctoria[23,24].

Thuja occidentalis is a shrub that was originally grown in Asia and North America. It is a natural European tree that grows up to 15–20 metres tall. It exhibits pyramidal coniferous characteristics, with flattened branches and twigs in one plane and tiny scale-like leaves [25]. The leaves are green throughout the year, with a brighter green on the bottom side where resin glands are also found. The seeds are contained in little, 1–2 cm long green to brown coniferous pins [26,27].

Figure 1: Thuja leaves and plant Image [28]

T. plicata essential oil has generally been used for wood preservation and insect repellant due to its antibacterial and insecticidal qualities [29–31]. Aborigines in the Pacific Northwest have long utilised T. plicata leaf oil to treat a variety of upper respiratory tract disorders [29]. Its essential oil also contains antibacterial and antifungal properties [30]. The high concentration of - and -thujone, the major physiologically active molecules in other essential oils with comparable antibacterial capabilities [32,33], is assumed to be responsible for its antimicrobial action.

Table 1 summarises the bioactive potential of Thuja species based on their uses. The current study provides an overview of the state-of-the-art in ethnobotany, phytochemistry, and a detailed analysis of the pharmacological properties of T. occidentalis, including antioxidant, anti-inflammatory, antibacterial, antifungal, anticancer, antiviral, gastrointestinal tract protection, radioprotection, antipyretic, and lipid metabolism regulatory activity, in order to promote all of the biological activities shown thus far, rather than the antitumoral activity.

Table 1: Thuja occidentalis' bioactive potential in comparison to those of other Thuja genus members.

Thuja occidentalis' bioactive potential in comparison to those of other Thuja genus members.			
Sr. No.	**Species of Thuja**	**Biological Activities-Related Benefits**	
		Medicinal Use	**Industrial Use**
1	T. koraiensis	antimicrobial [34,35]; antioxidant [36]	
2	T. occidentalis	antimicrobial [30,37–39]; antioxidant and anti-inflammatory [37, 40–44]; antitumor [45–48]; hepatoprotective and gastroprotective [49,50]; antidiabetic [51]; antiatherosclerosis[52]; radioprotective [53]; antipyretic [54]	antifungal agent for biocontamination control in libraries and archives storage areas [55]; insecticidal activity [56]
3	T. plicata	Antimicrobial [29,30,57]; Anti-inflammatory, immunomodulatory, and tissue remodelling[58]	Antimicrobial agent for decontamination of buildings [29]
4	T. standishii	Antimicrobial [61-63]; antitumor [61-63]	
5	T. suchuenensis	antimicrobial [59,60]	

Phytochemical constituents of T. occidentalis:

Fresh plant includes essential oil, reducing sugar, water soluble polysaccharides, water soluble minerals, free acid, tannic agents [64], flavonoids, saponins, glycosides, and alkaloids [65], according to biochemical investigations. The primary monoterpenes in the essential oil of fresh leaves (related to the monoterpene fraction) are 65 percent thujone, 8 percent isothujone, 8 percent fenchone, 5 percent sabines, and 2 percent -pinene1,3. Carvotanacetone, origanol, origanes, myrcen, and camphen are some of the other monoterpenes that have been described [64, 67-69]. The heartwood of T. orientalis includes aroma-dendrin, taxifolin, widdrene, cedrol, thujopsadiene, dehydro-curcumene, -isobiotol, and curcumenether, while the leaves contain rhodoxanthin. For 100 percent of the whole oil, T. orientalis essential oil revealed the presence of 38 compounds. -pinene (22.25 percent), 3-carene (20.65 percent), cedrol (18.71 percent), –Caryophyllene (6.13 percent), –humulene (5.68 percent), terpinolene (4.53 percent), and limonene (3.35 percent) were the primary components [70].An article discovered twenty-one molecules, with quantitative variations mostly between cone and needle oils. Both oils were high in monoterpene hydrocarbons, with the primary components being -pinene (64.2 and 49.3 percent in cones and needles, respectively), phellandrene (6.7–9.6 percent), and -cedrol (6.7–9.6 percent) (3.9 and 8.2 percent) [71].

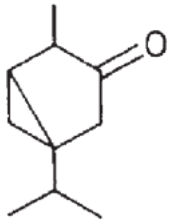

Figure 2: Thujone API of thuja occidentalis plant

It is the main element in the essential oil extracted from the dried herbal content of Thuja occidentalis plants. It contains 85% alpha-thujone and 15% beta-thujone[72].

Biological Activities

Antioxidant [40,42], anti-inflammatory [73], antibacterial, antifungal [30,37], antitumoral [46–48], antidiabetic [51], hypolipidemic, antiatherosclerosis [52], gastroprotective [49], antiviral, immunostimulant [74,75], radioprotector [53], and sedative [76] are just a few of the pharmacological properties of Thuja occidentalis. The impacts of thujone biological activities have begun to be used in pharmacological and therapeutic research.

a. Antipyretic Activity

In rabbits, a methanolic extract of Thuja occidentalis has antipyretic action. At dosages of 100 mg and 200 mg/kg body, it lowers fever and normalises body temperature, similar to paracetamol [54].

b. Antiviral Activity

Antiviral and immunostimulant properties of polysaccharides isolated from T. occidentalis have been demonstrated, with the capacity to suppress HIV-1 and influenza A [38,78].

c. Antioxidant Activity

The capacity of phenolic compounds to neutralise free radicals generated by cell metabolism is best defined as antioxidant capability [77]. The antioxidant capacity of the Thuja occidentalis methanolic extract was estimated to have high DPPH radical scavenging activities, ABTS, NO, and lipid peroxidation tests in a 2016 published research by Nazir et al. [40].

d. Anticancer Activity

On the malignant melanoma cell line A375, thujone produced from T. occidentalis ethanolic extract was demonstrated to exhibit anticancer effects. Thujone was found to have an antiproliferative impact and the potential to trigger apoptosis in the same research [45].

e. Lipid Metabolism Regulation

At a dosage of 200 mg/kg, the ethanolic fraction of T. occidentalis was demonstrated to exhibit hypoglycaemic characteristics in rats with alloxan-induced diabetes, with no effect on body weight. It has also been found to enhance lipid profiles and to protect against oxidative stress by boosting glutathione levels in the blood [51].

f. Gastrointestinal Tract protective effect

The ethanol fractions of T. occidentalis demonstrated a hepato-protective effect in acute and chronic liver-induced HCV, according to an article. The ethanolic fraction of T. occidentalis, according to the same researchers, has a significant impact against stomach lesions [50].

g. Radioprotective Activity

T. occidentalis was shown to protect Swiss albino mice from gamma-induced toxicity in this investigation. Alkaline phosphatase, pyruvate transferase, and lipid peroxidation were all decreased by the Thuja occidentalis alcoholic extract [53].

h. Anti-Inflammatory Activity

Inflammation is a basic defensive response that occurs in response to damaging stimuli and is used to restore damaged tissue. Gastric toxicity was not seen at high dosages of aqueous extract and polysaccharide fraction derived from T. occidentalis of 300 mg/kg [73].

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