Phytochemical Investigation, GC-MS Analysis, Antioxidant and Antimicrobial Potential of Himalayan *Cedrus Deodara*

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ABSTRACT

Cedrus deodara is a high altitude medicinal tree and traditionally the leaves and soft bark is used in Ayurvedic, Chinese and Tibetan medicine, it has been recognized for its diverse pharmacological properties. The present study aimed to evaluate the antioxidant potential and antimicrobial effect of leaf extracts obtained using different solvents. Antioxidant activity was assessed through standard assays, including DPPH radical scavenging, revealing a concentration-dependent free radical scavenging effect. The methanolic extract exhibited the highest antioxidant potential, correlating positively with its total phenolic and flavonoid content. Bioactive compounds were identified by GCMS. Antimicrobial activity was tested minimum inhibitory concentration (MIC) methods. Results demonstrated notable inhibition zones, particularly against *Staphylococcus aureus* and *Escherichia coli*, with the methanolic extracts showing superior efficacy compared to other extracts. These findings suggest that *Cedrus deodara* leaves are a promising source of natural antioxidants and antimicrobial agents, supporting their potential application in pharmaceutical formulations.

Keywords: *Cedrus deodara;* antioxidant capacity; antimicrobial effects; leaves extracts, Uttarakhand Himalaya

INTRODUCTION

Cedrus deodara, the deodar cedar, Himalayan cedar, or deodar is a species of cedar native to the Himalayas [1]. It is a large evergreen coniferous tree reaching 40–50 meters (131–164 feet) tall, exceptionally 60 m (197 ft) with a trunk up to 3 m (10 ft) in diameter. *Cedrus deodara* is an evergreen tree (conifer) almost rough black, bark and spreading branches, shoots with dimorphic leaves 2-8 cm needle like with sharp pointed, flowers are monoecious, but some branches Bear flowers with one sex (Figure 11.0). It has a conic crown with level branches and drooping branchlets [2]. All the parts of the flower are bitter, pungent, in nature. *Cedrus* is a genus of Pinacea with tropical as well as subtropical distribution. The genus is mainly comprised of trees which are cultivated may be for their usefulness for their ornamental purposes. Seeds usually shed in winter season. Deodara trees live up to 600 years. Flowers come in September to October. Drained soil is well for the growth of these trees. High moisture is favorable for the growth of the plant. Cold wind and frosts may cause injury to young trees [3].

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Figure 11.0. Cedrus deodara

The first half of plant name that is word Deva means divine, deity, Deus and the second part means durum, tree and true. Forest with devadaru trees was the favourite place of ancient sages who were devoted to Hindu god Shiva. So, this plant believed to be a sacred tree. In India total deodara forest are 2,03, 263 a comprising of 69,872 in Himachal Pradesh, Uttar Pradesh and Jammu and Kashmir [4].

Plant Profile

Scientific Classification

- **Kingdom:** *Plantae*
- **Division:** *Pinophyta*
- **Class:** *Pinopsida*
- **Order:** *Pinales*
- **Family:** *Pinaceae*
- **Genus:** *Cedrus*
- **Species:** *Deodara*
- **Binomial nomenclature:** *Cedrus deodara*

Vernacular Names: Himalaya cedar (english), devdaar, diar, diyar (hindi), devdaru, amara, devahvaya (sanskrit), devdaar (gujrati), deodar (marathi), devadaru, devadaram, devataram (malyalam), bhadradaaru, daevadaaru, gunduguragi (kannad), burada deodar, deodar (urdu), than-sin (tibetan), devadaram, tevataram, tunumaram (tamil), and devadaru (nepali) [5].

LITERATURE REVIEW

Cedrus deodara Essential oil is utilized as perfume fixative in essence, cosmetic, soap and perfume Industries. Generally, the *Cedrus deodara* is characterized by a high percentage of himachalenes [6]. It is enriched in atlantones is known as “Perfumery Grade” and the essential oil enriched with himachalene is called as “Super Rectified Oil”. Sesquiterpenes are partially being ascribed from Cedrus species [7]. Many pharmacological activities of *C. deodara* have been reported *in vivo* and *in vitro*. Various parts of this plant bear anti-inflammatory, immuno modulatory, antispasmodic, anticancer, antiapoptotic, antibacterial as well as other activities. The oil extract of wood was used for its oral anti-inflammatory activity. The extract showed significant result in induced rat paw edema process. The oil extract (Volatile) was also studied for its anti-inflammatory activity by the process of induced arthritis [8]. Wood oil of *C. deodara* showed significant analgesic activity. *C. deodara* oil of wood helps in inhibiting the adhesion of neutrophils to nylon fibers which are responsible for the simulation of blood vessels in the cells (margination). This shows that the *C. deodara* wood oil lessens the number of neutrophils in turn decreasing phagocytosis action and also the release of various enzymes that make inflammation even more worsen [9]. Himachalol is one of the chief constituents of wood of *C. deodara*, which likely to have antispasmodic activity. The pharmacological studies of himachalol on different isolated smooth muscles (Rat uterus, pig ileum and rabbit jejunum) and against various other agonist’s histamine, serotonin, nicotine, acetylcholine etc., proved spasmolytic activity. This antagonist activity had no relaxing effect when given alone [10]. Various Wood chips of *C. deodara* were used to get essential oils which are useful in antimalarial activity. *C. deodara* proved to contain two commonly acaricidal drugs that are OCD and Benzyl Benzoate (BB), respectively, which are used to cure infection of Sarcoptesmites. These drugs are applied on effected part in alternative days and recoveries in skin lesions were observed [11]. The alcoholic extract of *C. deodara* have significant anticonvulsant activity through GABA

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levels in brain. Traditionally the heartwood of *C. deodara* plant was used to enhance cerebral function, balance the mind, body connection, nervous system and strengthen the brain. It was reported to possess CNS depressant and neuroleptic activity [12].

Plant Material

Fresh plant material of *Cedrus deodara* was collected from Pauri region in month of February. Plant was identified by botany department of HNBGU Srinagar Garhwal. The fresh leaves and bark were hydrodistilled separately for 8hrs to get the colorless essential oil. Dried leaves were Successive extracted for extracts in different solvent (petroleum ether, chloroform, methanol. The essential oil was stored in a sealed vial for further analysis.

RESULTS

GC-MS of Essential Oil

The GC-MS analysis of *Cedrus deodara* resulted in the identification of twenty-five Constituents. Both the major as well as minor constituents were identified by their retention indices. Results of composition of essential oil is shown in Figure No.11.1 and Table No.11.1.

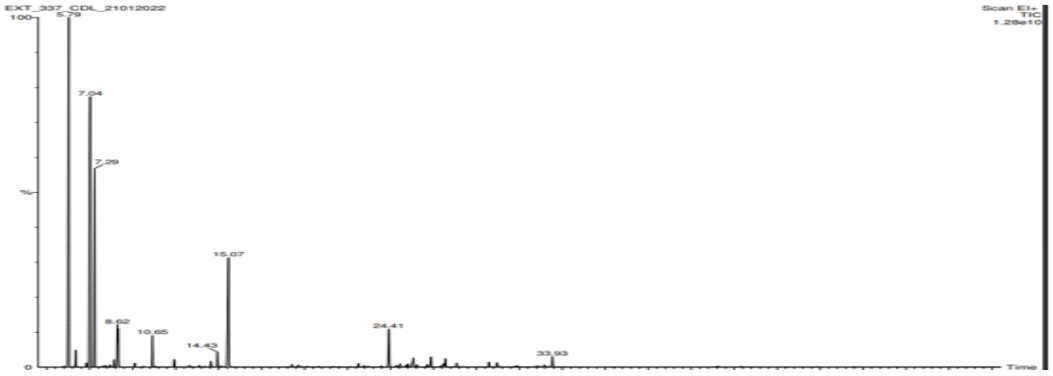

Figure No. 11.1. GC-MS Chromatogram of the composition of essential oil of *Cedrus deodara*

Table No. 11.1: Chemical composition of essential oil of *Cedrus deodara*

S.No	Compound	Molecular formula	Molecular weight	RF
1.	Patchouli Alcohol	$C_{15}H_{26}O$	222.36 g/mol	876
2.	Cadinol	$C_{15}H_{26}O$	222.37 g/mol	877
3.	Calarene	$C_{15}H_{24}$	204.35 g/mol	878
4.	Azulene	$C_{10}H_{8}$	128.17 g/mol	890
5.	Naphthalene	$C_{10}H_{8}$	128.18 g/mol	895
6.	Aromadendrene	$C_{15}H_{24}$	204. 35 g/mol	903
7.	Baliencene	-	-	922
8.	Cis caryophyllene	$C_{15}H_{24}$	204.36 g/mol	938
9.	Camphene	$C_{10}H_{16}$	136.24 g/mol	943
10.	Sabinene	$C_{10}H_{16}$	136.23 g/mol	944

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11.	D-limonene	$C_{10}H_{16}$	136.23404 g/mol	951
12.	Cymol	$C_{10}H_{14}$	134.21 g/mol	962
13.	Rothrockene	$C_{10}H_{16}$	136.23 g/mol	960
14.	Exoborhyl acetate	-	-	821
15.	Guaiyl acetate	$C_{17}H_{28}O_2$	264.4 g/mol	798
16.	Isocyanoneopupukeanane	$C_{14}H_{12}N_2O$	224.26 g/mol	789
17.	Calanene	Fe2O4Zn	241.1 g/mol	776
18.	Epizonarene	$C_{15}H_{24}$	204.36 g/mol	775
19.	Longifolene	$C_{15}H_{24}$	204.36 g/mol	773
20.	Junipene	$C_{15}H_{24}$	204.36 g/mol	769
21.	Di limonene	$C_{10}H_{16}$	136.24 g/mol	762
22.	Camphene	$C_{10}H_{16}$	136.24 g/mol	946
23.	Geraniol formate	$C_{11}H_{18}O_2$	182.26 g/mol	907
24.	Berrylacetate	$C_6H_{12}O_2$	116.16 g/mol	875
25.	Myrtenyl acetate	$C_{12}H_{18}O_2$	194.27 g/mol	853

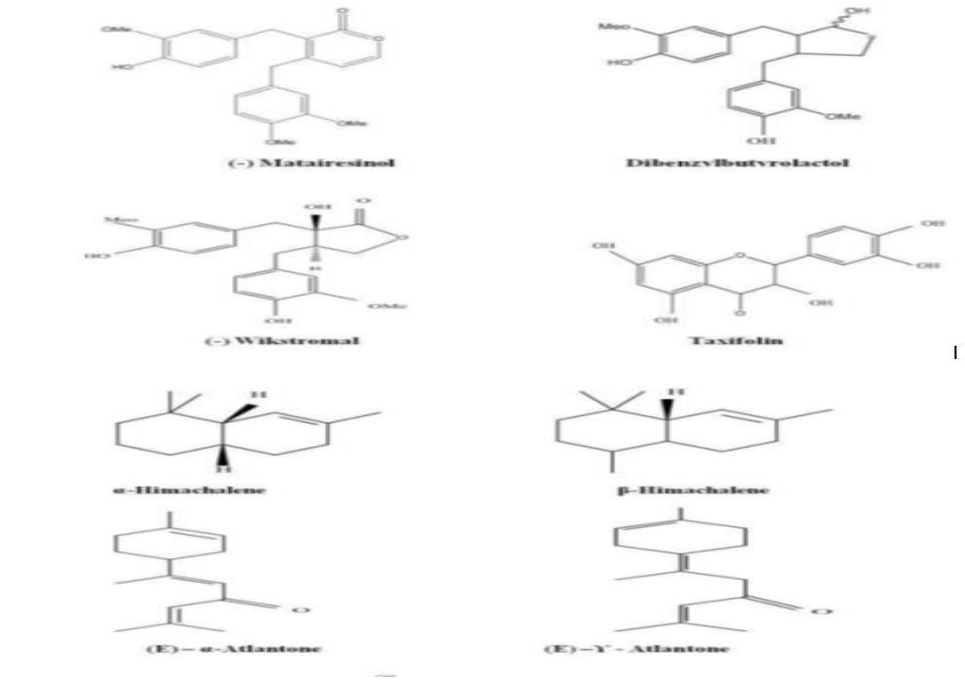

Figure No. 11.2: Structure of composition of essential oil

Phytochemical analysis

Phytochemical screening of petroleum ether extracts, chloroform extracts, methanol extracts of *Cedrus deodara*.

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Table No. 11.3: Phytochemical Screening of different Extract of *Cedurus deodara*

S.No.	Test	PE	*CE*	*ME*	*AQE*
1.	Carbohydrates-Molisch's test	-	-	+	+
	Fehling's test	-	+	+	+
	Benedict's test	-	-	+	+
2.	Alkaloids- Mayer's test	-	+	+	+
	Wagner's test	-	+	+	+
	Dragendroff's test	-	+	+	+
3.	Glycosides- Killani's test	-	-	+	+
	Legal's test	-	-	+	+
4.	Phenols-Folin- Cioclteau's test	-	+	+	+
5.	Flavonoids-H_2SO_4/Mg test	-	-	+	+
6.	Saponin- Foam's test	-	-	+	+
7.	Tannins-Gelatin's test	-	-	+	+

Anti-oxidant activity

The results of the antioxidant activity suggest that, polar extracts of *Cedrus deodara* had significant antioxidant potential in comparison to non-polar extracts. The results of antioxidant activity are shown in **Table No. 11.3.**

Table No. 11.4: Antioxidant activity of different Extract of *Cedrus deodara*

Extracts and Standard	DPPH free radical scavenging activity (IC50)
PEE	2.24±0.12
CE	3.00±0.10
ME	4.18±0.24
AQE	5.05±0.050
Standard (Ascorbic acid)	6.22±0.81

Antimicrobial activity

The antimicrobial activities of polar and non-polar solvent extracts of *Cedrus deodara* were determined against *E. coli*, *B. subtilis* and *S. aureus* via well diffusion method. The significant highest zone of inhibition was recorded of polar extracts against all the bacterial strains studied in comparison to non-polar extracts. The results of antimicrobial activity follow the order as- Methanolic extract> Hydro-alcoholic extract>water (aqueous) extract> Hexane extract>chloroformic extract> petroleum ether extract. The results are shown in Table No. 11.5 and Figure No. 11.3.

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Table No. 11.5: Antimicrobial Activity of Solvent Extracts of *Cedrus deodara*

Bacterial Pathogen	**Diameter of zone of inhibition (mm)**			
	ME (100 µg/ml)	**AQE (100 µg/ml)**	**CE (100 µg/ml)**	**PE (100 µg/ml)**
***B. subtilis* (MTCC 441)**	14.0	8.0	9.0	7.0
***S. aureus* (MTCC 441)**	8.0	14.0	21.0	16.0
Pseudomonas aeriginosa* (MTCC 441*)	7.0	No Zone	No Zone	4.0
***Proteus vulgaris* (MTCC 441)**	12.0	27.0	No Zone	11.0
***E. coli* (MTCC 441)**	11.0	8.0	No Zone	7.0
***Klebsiella pneumnia* (MTCC 441)**	15.0	20.0	No Zone	5.0

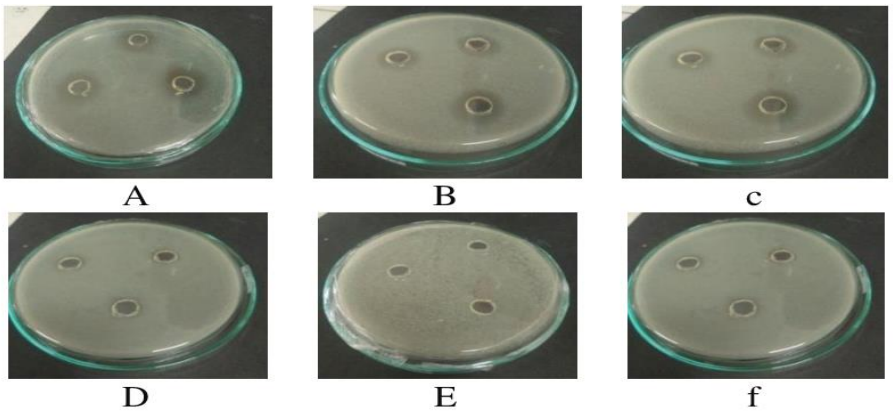

Figure No. 11.3: Antimicrobial Activity of Different Extracts of *C. deodara*

DISCUSSION

C. deodara have many qualities and features including anti-inflammatory, antitumor, anti-bacterial, antifungal and various other and possesses great influence on nervous system. Various studies can be conducted in multiple animalbased models for understanding their mechanism of action.

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