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A REVIEW ON *JUNIPERUS EXCELSA*: DESCRIPTION, DISTRIBUTION AND ECOLOGY, ETHNOBOTANY AND BIOLOGICAL ACTIVITIES

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Abstract

Medicinal plants believed to have some medicinal properties and are extensively being used in herbalism. In tribal and rural areas for healthcare purposes they are the easily available source. A distinct branch of natural science which deals with numerous aspects such as archaeology, medicine and economics, cultural, religious, ecology, anthropology, botany and a number of other disciplines is called Ethnobotany. Worldwide greater importance in the above given studies of traditional remedies and herbal drugs is indicated and increase in the scientific investigation has been seen in this area. About 80% of world's population rely upon these medicinal plants products, because they are thought to be as economical, effective and safe. Herbal plant Juniperus excelsa is extensively used as condiments, spice, herb and also use for the treatment of variety of diseases in traditional system. To review the ethnobotanical properties of Juniperus excelsa plant the present study was aimed. Different tribal communities widely uses various parts of this plant. The leaves of plant are used to lowering blood pressure, wound healing, intestinal worms, liver disease, bronchitis, treatment of hyperglycemia, ulcers, pneumonia and tuberculosis in traditional medicine. Researchers made numerous efforts through scientific biological screening to verify the efficacy of the plant. Some important pharmacological activities of the plant revealed after scrutiny of literature such as cytotoxic activity, antioxidant property, antifungal, antibacterial, anticholinesterase, antitumor, antileishmanial and antifouling potential and many more medicinal values.

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INTRODUCTION:

Man uses herbal plants to fulfill their basic necessity clothing, food and shelter. Herbal plants supply cosmetics, medicines and crafts to urban and rural population. Moreover, Herbal plants are source of employment and earnings to the rural areas [1]. Essential medicinal plants products are dietary supplements, aromatic plants, fragrant products, spices, essential oils, medicinal raw materials, flavoring, functional food ingredients and herbal teas. Around the globe medicinal plants are used for thousands of years as a medicines. According to WHO (World Health Organization) approximately 80% of developing countries population for primary care still rely on herbal plant based medicines. In Asia, different system of medicinal usage are practiced like Chinese traditional system, unani, siddha, local health traditions and Ayurveda, uses huge amount of herbal plants for cure of animal and human ailments. These were called as medicinal plants. Pakistan has a long and rich history of natural resources and traditional medicines. Biologically active compounds are present in herbal plants which are helpful in treatment of diseases and improving the life. Compounds such as phenolics, terpenoids, proteins, sterols, oils, carbohydrates, enzymes, fats, flavonoids etc. In primary health care system, the rich source of traditional and synthetic herbal medicine are natural products. Presence of various biologically active plant constituents persuaded scientists to evaluate these herbal plants for their use in management of chronic wounds and treating certain ineffective diseases [2].

Folklore herbal literature describes the effective part of medicinal plants as a source of various vitamins and a local cure for many conditions such as arthritis, cancer, diabetes etc. Both locally and internationally there has been relative increase in demand of medicinal plant products. The demand for medicinal plant products is due to increasing awareness of medicinal plant products, limited access to doctors, poverty, population increase and high cost of modern medicine. From one locality to other variations have been seen in type of plants and their parts being removed and their use basically depends on experience present over countries and local indigenous knowledge. Alternate cure and control by natural herbal products is the basis of modern day research. Herbal plants are cheaper and easily available to the most population around the globe. Hence, there is need for scientific evaluation of these herbal plants which may be an effective alternate source of drugs available in market. High increased interest have been developed around the world for herbal remedies [3]

Since from the start of this century, study of herbal plants and their folklore use in various parts of the world have been a growing concern [4]. With synthetic drugs available in market for number of diseases, medicinal plants are the significant resource for developing novel drugs to treat different ailments. *Juniperus excelsa* is one of the medicinally important herbal plant, whereupon the presence of Ethnobotany and scientific significance is being reviewed.

Taxonomy of plant

Kingdom: Plantae
Phylum: Tracheophyta
Division: Pinophyta
Class: Pinopsida
Order: Pinales
Family: Cupressaceae
Genus: Juniperus
Species: *Juniperus excelsa*

JUNIPERUS EXCELSA

Plant species, *Juniperus excelsa* belongs to the family *Cupressaceae*. Approximately more than 70 species are generally distributed around the globe [5] and only in North America more than 15 species are present [6, 7].

DESCRIPTION:

HABIT: tree, maximum height 25-20 m, dbh 2.5-1.5 m or more, rarely a prostrate shrub or a shrub, branches of higher orders: Less or more rising in juvenile trees, finally in old trees somewhat pendulous and spreading;; branches of first order ascending or spreading, frequently monopodial in tree forms; twisted in old trees, bark (young trees, branches) smooth, on old trees longitudinally furrowed, branchlets very dense especially in dry environment, more irregular or numerous, in dorsiventral sprays (young trees), crown: mature trees shrub like to prostrate in alpine location or irregular, broad, very fine, persistent, quadrangular to more or less cylindrical, diameter 0.7-1 mm, (broad) pyramidal in young trees, ultimate branchlets covered with leaves, reddish-brown, later fibrous, purplish-to reddish-brown, soon with papery flakes, peeling in long strips. Leaves: young leaves on lower or on seedlings, acicular, ternate, mature leaves scale-like, covered branches of trees, keeled, pungent, at base widest c. 8-10 x 1 mm, appressed, imbricate, decussate or free at the mostly incurved apex, 0.6-1.1 x 0.4-0.8 mm, with entire margins, (ob)lanceolate-acute on older shoots (-3.5 mm long), ovate-rhombic on ultimate branchlets, recurrent at base; glands conspicuous and large, nearly circular to elliptic, frequently sticky, on young leaves epistomatic in often 2 ordinary lines tapering from apex to base; a single median resin cavity occurs in mature as well as in juvenile leaves, stomata on mature leaves amphistomatic color, yellowish-green or light green. Seeds: 4-6 x 3-4 mm, (2-) 3-6(-8) per cone (some ovules usually abort), ovoid but curved or flattened, broadest at base, yellowish to reddish-brown, angular. Microsporophylls: thin margins with rounded 8-10 peltate, 3-4 pollen sacs each bearing Male strobili: 3-4 x 2-3 mm, subterminal or terminal on ultimate branchlets, solitary and numerous, greenish maturing yellowish. Female cones: subterminal on ultimate branchlets, sessile, axillary and mostly solitary, numerous; surrounded by bracts or green leaves, young strobili stellate-spheroid, 2-3 mm diameter, blue to purplish-green; mature cones globose, often pruinose, 1 mm diameter, blackish-purple to purplish-brown; seed scales 4(-6), waxy, decussate, at the distal pole of the cone two largest meeting, 4-9 mm long, entirely fused with bracts and each other, becoming woody, with a ridge terminating in a small umbo (0.5-0.6 mm), surface smooth, yellowish (in sicco), interior resinous.

Following characters differentiate *Juniperus excelsa* subspcie *polycarpos* from the typical subspecies: often irregularly intricate and disposed, thicker (1-1.3 mm), larger (0.8-0.9 x C mm), Ultimate branchlets, more quadrangular, leaves on ultimate branchlets sometimes free at apex; typical subspecies have similar female cone but with on average less seeds (2-)3-4(-6) and more variable in size, sometimes larger (diameter up to 14 mm in e.g. R. Dunckelman 46 from Gardez, Afghanistan).

DISTRIBUTION AND ECOLOGY:

Tadzhikistan, Pakistan (Baluchistan), Elburz Mountains (Iran) to Kopet Mountains (near Ashkhabad) in Turkmenia, Cyprus, Greece (Thraki , Macedonia & Euboea), Syria, Turkey (eastward to Armenia and Anatolia), Albania, S Bulgaria, India (Himachal Pradesh), Uzbekistan, Afghanistan,

Georgia, Yugoslavia (Macedonia), Azerbaijan, Armenia and Lebanon [8]. Zone 6(cold hardiness range between -17.8°C and -23.2°C) to hardy. In the hills of the Eastern Mediterranean Basin and in mountains, around the southern end in the mountains of Caspian Sea and the Black Sea *Juniperus excelsa* M.-Bieb. Subsp. *excelsa* are present. Latter chain of mountains along the Eastward it's infrequent. It's also not found in those areas where annual precipitation is below 500mm. Commonly, found with annual precipitation between 500-1000 mm regions like on the Crimea and in Anatolia (less so in its central part). Its altitudinal range is from 2300 m in the Turkey and Caucasus to 100 m (e.g. Crimea).In several mountain ranges it forms the tree-limit. It grows mostly on non-calcareous slopes, rocky calcareous or stony areas. It's resilient to warmth and summer famine, but not as much of the subspecies *polycarpos*. Open forests, form pure or in secondary vegetation it may be part of oak-scrub communities, but not in Mediterranean marquis. It may grow mixed with other conifers such as *Pinus, Cupressus sempervirens* and *Cedrus libani* spp., or with *J. foetidissima*. From the mountains in Turkey around Çoruh Valley to the Caspian Sea eastward across the Caucasian Region *Juniperus excelsa* subsp. *polycarpos* are found. Therefore, it occurs along the Kopet Mountains into Afghanistan and around the Caspian Sea. As far as in the south (east) range it is found in Himachal Pradesh (India) and Quetta in Pakistan, northeastward it reaches the mountains of Kirgizstan and the Tian Shan. West of the great desert plateaus in Iran mostly are scattered along the mountain chains; finally, in Oman on Jabal-al-Akhdar there is a distinct population. Irano-Turanian Region in the Western Asiatic Sub-region, and particularly in the Armeno-Iranian Province, which categorized by mountains separated by vast deserts and steppes where *Juniperus excelsa* are found. Subsp. *polycarpos* is much more a continental taxon than the typical subspecies. It forms a disjunct enclave in province of Oman at the Jabal-al-Akhdar, which has its western limit in the eastern parts of Turkey roughly from Maras to Gümüshane. *Juniperus excelsa* subsp. *polycarpos* are not found in west of this line. Only in Armenia (including Turkish Armenia) typical subspecies are possibly sympatric and the typical subspecies becomes increasingly rare around the southern end of the Caspian Sea eastward along the mountain chains from Azerbaijan. In these mountains precipitation is still comparatively high (annually well above 500mm). Farther east in Afghanistan and in Uzbekistan and Tadzhikistan often recognized as *Juniperus excelsa* subsp. *polycarpos*, *J. seravschanica* which are found in large quantity, with outposts on the northern limits in the western Tian Shan and at the southeastern end of its range in India (Himachal Pradesh). This range has less abundant precipitation; mostly in winter it comes as a snow. It matures extremely slowly and groves of very old trees occur in most areas, with no or little rejuvenation. Generally, it's a taxon of higher altitude and further it reaches eastwards, the higher height it attains it occurs from 500-3800 m, however for the most part between 1200-3000 m. Than the typical subspecies it is unequivocally heliophilous and substantially more impervious to radiation (heat) and drought, yet it can stand winter cool similarly well. Thick cuticula prevents from dehydration. In Iran in the *Junipereto-Pistacietea* steppe forest subsp. *polycarpos* is prevailing, with *P. atlantica* and *Pistacia khinjuk*. It occurs on often spaced wide apart, rocky slopes, stony and sometimes mixed with *J. semiglobosa.* [9].

ETHNOBOTANICAL USES:

In Balochistan (Pakistan), *Juniperus excelsa* is one of the most significant herbal plant [10]. *Juniperus excelsa* is traditionally used for Dysmenorrhea [11], Tuberculosis, Jaundice, common Cold, Bronchitis, Cough [12]. Traditionally *Juniperus excelsa was* used for Asthma in Iran [14]. *Juniperus excelsa's* essential oil possessed a good antioxidant activity [15]. *In vitro* studies of *Juniperus excelsa two* sub-species showed potential cytotoxic activity on three cell lines [16].

From ancient civilization Juniperus berries (fruits), essential oil and wood have been used, in the Middle Ages for many illnesses it was known as a traditional remedy, as well as used as a digestive and diuretic. Particularly, Juniperus berries were believed to clean the air where it was used as a fragrance.

Anatolian people since ancient times use Juniperus leaves, fruits and their woods. The coniferous leaves and parts of Juniperus are used in cosmetic industry and in medicine and as an antiseptic, stimulant, diuretic and anthelmintic [17].

J. excelsa is used in traditional medicine mainly for lowering blood pressure [18]. Its essential oil is also widely used in aromatherapy for cosmetics and fragrances, soaps, scent masks, lotions and remedies, mood scents and candles [19]. In Oman, it is also used traditionally for bronchitis, the common cold, jaundice and tuberculosis [20–26]. Other species of juniper are used for the treatment of intestinal worms, bronchitis, pneumonia, tuberculosis, wound healing, liver disease, ulcers and hyperglycemia in traditional medicine [19]. In Turkish traditional medicine, juniper species are mainly used as diuretics, stimulants, antiseptics and for wound healing [20, 22]. The essential oil of *J. excelsa* is reported to have strong antimicrobial, antioxidant, antifungal, antiviral and antispasmodic activities.

BIOLOGICAL ACTIVITIES:

Cytotoxicity

J. excelsa subsp. polycarpos and *Juniperus excelsa* subsp. excelsa terminal branchlets and berries of different concentrations were screened on cancer cells (MDA-MB-468, Hela and KB cells) for its cytotoxic effects by ELISA, using MTT assay. The extracts of the berries of *J. excelsa* subsp. excelsa as well as branchlets of female and male of *J. excelsa* subsp. polycarpos against KB cells showed inhibitory activity. Extracts of *J. excelsa* subsp. polycarpos berries and female branchlets were showed cytotoxic activity against all 3 cancer cell lines. Whereas, *J. excelsa* subsp. polycarpos showed cytotoxicity which was comparative to doxorubicin against most of the tested cell lines; however, against KB cells berries of *J. excelsa* subsp. *excelsa*'s exhibited inhibitory effects only [16].

In other study, cytotoxic effects of the extracts of *Juniperus excelsa* against Human hepatoma (HepG2) cell lines were investigated. Cytotoxicity was assessed by MTT test, and comparison of the IC_{50} revealed that the extract of aerial parts of the *J. excelsa* had the strongest cytotoxic effects with IC_{50} of 0.54±0.04 mg/ml. The cytotoxic effects of *J. excelsa* is seemed to be due to ATP depletion as ATP levels of HepG2 cells incubated for 24 h with 0.5 and 0.7 mg/ml of the extracts of *J. excelsa* was decreased to 47% and 27% of control, respectively [27].

Cytotoxic activity of the *Juniperus excelsa* were evaluated and found to be highly active against KB-V (+VLB), KB-V (-VLB), and LNCaP (human colon cancer cell line). The extract of hexane was found to be active especially against (LNCaP) (ED50=1.3 µg ml^{-1}) as well as KB-V (-VLB) (ED50= 2.5 µg ml-1) and KB-V (+VLB) (ED50= 2.5 µg ml-1) while against P388 cells and cultured KB compound **1** (Juniperexcelsic acid) and methanol extract were only tested and a weak cytotoxic response was indicated with KB cells (ED50= 10.5 µg ml-1). Against ASK 9 glioma cell hexane extract also showed a positive response [5].

Cytotoxicity of *Juniperus excelsa's* essential oils were tested against Multidrug-resistant P-glycoprotein-expressing CEM/ADR5000 leukemia cells and drug-sensitive CCRF-CEM fby using resazurin assay (reduction of the indicator dye resazurin to the highly fluorescent resorufin by viable cells) and resulting IC¬50= 41.50 and 44.85 µg/mL respectively, and the degree of resistance which is dividing the IC50 of CEM/ADR5000 cells by the IC50 of CCRF-CEM cells and it was 1.08 [28].

The cytotoxicity activity of different crude extracts from *J. excelsa* was determined by brine shrimp lethality method. Hexane, chloroform and ethyl acetate extracts have displayed activity against the brine shrimp larvae. Mean percent mortalities of shrimp larvae exposed to different leaves crude extracts of *J. excelsa*. Chloroform extract killed all shrimp larvae (percent mortality 100%) at 500 µg/mL highest concentration and exhibiting LC_{50} value of 74.89 µg/mL. Percent mortality for hexane extract at the same concentration was 95%. The highest cytotoxic activities were shown by chloroform extract. The order of activity was chloroform > hexane > ethyl acetate [29].

Juniperus excelsa from southern Iran provinces has been extracted with methanol and screened for their cytotoxic activity against MCF-7, WEHI-164, HepG-2, MDBK and A-549 cell lines by MTT assay where *Juniperus excelsa* only showed cytotoxicity against MCF-7 with IC_{50} 31.51 µg/mL [30].

ANTIOXIDANT:

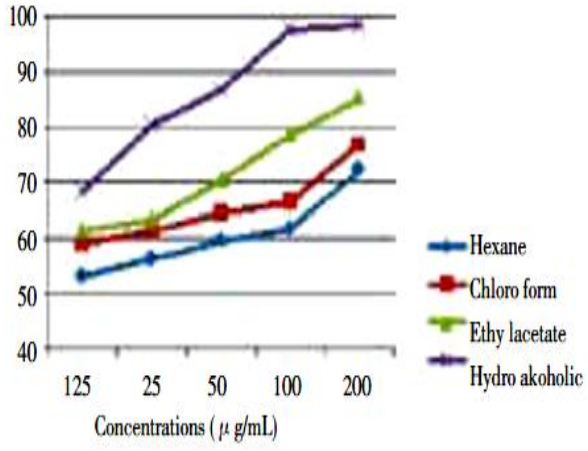
Antioxidant activity of six Turkish juniper species were evaluated by two assays i.e. DPPH assay for free radical scavenging activity and β-carotene–linoleic acid assay for total antioxidant activity where acetone extract of *Juniperus excelsa* showed moderate activity in both the assays with IC_{50} values 64.04 and 83.77 µg/ml respectively [17].

Furthermore, antioxidant activity of the essential oils of fruits and branchlets of *J. excelsa* subsp. polycarpos and *J, excelsa* subsp. excelsa were tested. To evaluate the antioxidants activity deoxyribose degradation test, diphenylpicrylhydrazyl (DPPH) assay and thin-layer chromatography (TLC) screening methods were employed. Color changing to yellow in thin-layer chromatography (TLC) screening method indicated that essential oils of different parts of plants possessed antioxidant effect but it was not decisive which chemical compounds were responsible and needed further testing. In DPPH assay, amongst the all tested pure compounds and volatile oils of different parts of plants, γ-terpinene and oil of female leaves possessed highest percentage of antioxidant activity with 17.7% and 16.8% at 4µL/mL, respectively. Moreover, in deoxyribose degradation assay i.e. the ability of a compound to remove hydroxyl radical and prevent sugar from degradation was tested. In which β- pinene showed highest activity amongst the pure compounds whereas none of the tested volatile oils possessed remarkable antioxidant activity which may be because of variability in the amounts of compounds and their specific activity in deoxyribose degradation assay [31].

Antioxidant activity and phenolic content of *Juniperus excelsa* was investigated by different antioxidant assays where ethyl acetate fraction showed highest activity with IC_{50} (204.3±12.8 µg/ml). In inhibition of β-carotene oxidation, ethyl

acetate fraction had a remarkable effect (antioxidant activity coefficient, ACC= 960±20). The results showed that, the polar fractions of *Juniperus excelsa*, especially ethyl acetate, had more antioxidant activity than the rest of the extract and fraction [32].

Free radical scavenging activity of the leaves crude extracts of *J. excelsa* were tested using DPPH method. The four leaves crude extracts of J. excels were able to decolorize DPPH. The free radical scavenging potentials of the leaves crude extracts were found to be in order of hydroalcoholic extract>chloroform extract> ethyl acetate extract>hexane extract [29].



Methanol extracts of 11 different taxons of Iranian conifers leaves, of male and female and fruits of were evaluated for their antioxidant activity. The antioxidant activity of leaves methanol crude extracts of *J. excelsa* was measured using two different tests of the thiobarbituric acid and ferric thiocyanate method. The results showed that they possess strong antioxidant activity as compared with those of butylated hydroxytoluene and α-tocopherol [33].

Radical scavenging activity of three juniper species of Macedonia were evaluated against DPPH radical. Both water and ethanol extracts of *Juniperus excelsa* possessed radical scavenging activity against DPPH radical but water extract was more powerful with % of inhibition of DPPH 67.40% (10 mg/ml). Obtained results showed correlation with the content of total phenols as the water extracts contained higher amounts of total phenols and exhibited better antioxidant activity [34].

ANTIFUNGAL ACTIVITY:

Twig and leaf of *Juniperus excelsa* of Lebanon were tested against *candida albicans* and *Trichophyton rubrum.* Antifungal activity of twig and leaf against *candida albicans* were not that much significant whereas twig and leaf against *Trichophyton rubrum* showed MIC (128 and 64 µg/ml respectively). Moreover, in the essential oil three main compounds were isolated and tested in combination and separately in their respective amounts. δ-Car-3-ene was the most active component with MIC 64 µg/ml against *Trichophyton rubrum* and is undoubtedly one of the constituents driving the antifungal activity of *J. excelsa* essential oil [35].

Hexane extract, methanol extract and sandracopimaric acids (a diterpene *of juniperus excels*a) were tested against *candida albicans* and it showed significant zone of inhibition ranging from 19-27 mm [5].

Anticholinesterase Activity

An agent that inhibits butyrlcholinesterase and acetylcholinesterase, which is chief enzyme in the pathogenesis of Alzheimer's disease. Acetone, Methanol and Hexane extracts were prepared from Six Juniperus species of Turkish origin were screened *in vitro* against BChE and AChE enzymes at 200, 100, 50, and 25 μgmL^{-1}. Where hexane extract of *Juniperus excelsa* showed 26.85% at 200µg/mL inhibition against AChE enzymes and it showed 58.35% inhibition at 200µg/mL against BChE enzymes [17].

In vitro butyrylcholinesterase (BChE) and acetylcholinesterase (AChE) inhibitory and antioxidant activities of the ethanol and aqueous extracts of the unripe fruits, ripe fruits and leaves of *Juniperus excelsa* was investigated using ELISA microplate reader method. Where leaf H_2O extract at 200µg/ml showed maximum activity against both BChE and AChE with inhibitory % 42.28 ±2.43 and 41.10±1.92, respectively [36].

Antibacterial activity

Berries of six juniperus species growing in Anatolia were tested for *in vitro* antibacterial activity of against 29 bacterial species, including multiple antibiotic-resistant bacteria in which hexane, methanol and acetone extract of *Juniperus excelsa* berries showed activity against *M. luteus, P. vulgaris, S. aureus, S. maltophila, S. capitis, S. epidermidis and S. xylosus* [17].

Essential oils (EOs) of twigs and leaves of *Juniperus excelsa M.Bieb.* growing wild in Lebanon were isolated and characterized and then evaluated for their antimicrobial activity. *J. excelsa* against *Staphylococcus aureus* showed interesting *in vitro* antibacterial activities. In which naturally occurring *Juniperus excelsa showed* significant activity whereas three major essential oils (α-pinene, α-cedrol, and δ-car-3-ene) were individually tested for antibacterial activity which did not show significant activity. Moreover to check the synergy between these major essential oils it was synthetically formed

but it also did not show significant activity as comparable to the naturally occurring *Juniperus excelsa* which may be expected due to the other minor components present in the plant [35].

Thirty-three plant species in Khyber Pakhtunkhwa, Pakistan belonging to 26 families are conventionally used for treating diarrheal diseases. Against five bacterial species fhese medicinal plants were evaluated for their antibacterial activity where Ethanolic extracts of *Juniperus excelsa* showed moderate activity against all five tested species of bacteria at 30(mg/ml) concentration [37].

One new (3α-ace-toxylabda-8(17), 13(16), 14-triene-19-oic acid (juniperexcelsic acid)) and four known compounds (sandracopimaric acids, (−)ent-trans communic, isocommunic, and isopimaric) of diterpenes of *Juniperus excelsa* of Isparta, southwestern, Turkey were isolated and identified. Amongst all compounds only sandracopimaric acid along with methanol and hexane extract were evaluated against seven different species of bacteria. Where, methanol extract on an average showed significant activity against all seven species as compared to hexane and sandracopimaric acid [5].

Effect of different polarities leaves crude extracts of Omani *Juniperus excelsa* were evaluated against gram positive and negative food borne bacterial pathogen (*S. aureus, E. coli and P. aeruginosa*). In which hexane and hydroalcoholic extracts showed strong inhibition against *P. aeruginosa* and *S. aureus* within ranged between 6–13 mm whereas *E. coli* was resistant to both the extracts [29].

The antimicrobial activity of Lebanese *Juniperus excelsa M*. Bieb Essential Oils (EO) were compared with (CHX) chlorhexidine, (a FDA-approved chemical antiseptic agent) against *Aggregatibacter actinomycetemcomitans* and *streptococcus mutans*. The ability of EO to inhibit the growth of bacteria demonstrated by zone of inhibition. Against both *S. mutans* and *A. actinomycetemcomitans* the experiments reported that the 1/10 diluted *J. excelsa* EO possessed antimicrobial activity, and its equivalent to that of CHX used at a concentration of 0.05% [38].

Chemical composition and antibacterial activity of two Juniperus species essential oils using disc diffusion method were evaluated against thirteen bacterial species. *J. excelsa* essential oils results indicated that it possesses antibacterial properties which ranged from 6-25mm approx. against all thirteen bacterial species. Furthermore, gram positive species were more susceptible than gram negative species which might be due to the presence of outer membrane in gram negative species. It resulted that *J. excelsa*'s essential oils can be used as a natural antibacterial agents to preserve food and to treat infectious diseases [39].

Antileishmanial Activity

In vitro Antileishmanial activity of *Juniperus excelsa* berries were carried out where chloroform fraction (CCF) showed substantial Antileishmanial activity with ED_{50} value 14.4µg/ml comparatively to the standard drug Amphotericin B [20].

Antitumor Activity

Juniperus excelsa berries were tested for antitumor potato disc assay by using *Agrobacterium tumefaciens* (At-10), where crude methanolic extract (CME) showed significant antitumor activity with % inhibition of 86.6% [20].

Antifouling

Juniperus excelsa berries were tested for antifouling activity against *Artemia salina.* Where ethanol extract of *J. excelsa* showed strong antifouling activity [40].

CONCLUSION:

Traditional and ethnobotanical uses of natural compounds particularly compounds derived from herbal plants have received a lot of consideration as they are generally believed safe for human and tested well for their efficacy. They apparently deserve analysis on modern scientific lines such as toxicity studies, their clinical trials, study of molecular mode of actions of isolated phytoprinciples, biological activities on experimental animal models and phytochemical investigation. For management of various diseases it's the best conventional method in search of novel active compounds. Comprehensive evaluation on literature available on *Juniperus excelsa* showed the fact that Hakims, ayurvedic practitioners, Vaidyas and among the various ethnic groups its popular remedy of variety of diseases. To identify the therapeutic potential of this plant very little effort have been made by the researchers due to the folk and traditional claims. It's worth noting that pure compounds and crude organic extracts of leaves of *Juniperus excelsa* have been found to possess and evaluated for some pharmacological activities such as cytotoxic activity antioxidant property, antifungal, antibacterial, Anticholinesterase, antitumor, antileishmanial and antifouling activity and many more useful therapeutic properties. Seed oil, leaves and seeds of different parts of plants which are documented to possess important medicinal virtues, which have not been scientifically evaluated for their biological activities.

In future study, to understand the precise molecular mode of action and search for active molecule from natural resources the isolated active principles should

be assessed in scientific manner using scientific experimental animal models and clinical trials.

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