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Studies on Several Medicinal Benefits of Plant *Juniperus communis*

Mrunal Sanjiv Kapadnis*, Saylee Pawar, Rupali Dhikale, Anil Jadhav

Abstract

Juniperus communis Lin is a fragrant evergreen plant of family *Pinaceae*; Cupressaceae. The aromatic shrub has great potential in treatment of human and animal diseases. The plant is great source of invert sugars, wax, gums, resins, flavonoids leucoanthocyanins, organic acids, aromatic oils, terpenic acids, alkaloids, tannins, lignins, catechin, etc. Berries of juniper or plant extract used as emmenogogue, sudorific, carminative, diuretic, urinary antiseptic, digestive, and anti-inflammatory. The experiments have demonstrated that the plant's extract as well as essential oils from plant have antifungal, antiviral, antioxidant, and antibacterial activities. Recent studies uncovered the hypolipidemic and cytotoxic activities from *Juniperus* berries in experimental study. Recent study also shown the insect repellant and insecticidal activity. Thus, the plant or shrub is treasure of medicinal properties, of which some are discovered and some are undiscovered. There is need to study the plant for new activities that can aid in treating many chronic diseases.

Keywords: Cupressaceae, Evergreen, Juniper, *Juniperus communis*, Shrub

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Introduction

Nowadays, people are giving more preference to herbal medication due to less adverse effects and more beneficial effect on physiological system. Rather than a synthetic medicine with a single specific activity, an herbal plant contains a variety of medicinal properties which are selected. India has oldest and diverse culture of medicine from ancient time. India has around 8,000 medicinal plant species, according to the Botanical Survey of India. *Juniperus communis*, a member of the Cupressaceae family of plants, is type of plant or shrub which has medicinal properties. Juniper is sweet-smelling shrub or plant, well-recognized source of cedar wood oil distributed in northern hemisphere extending toward south (Africa). Plant shows various pharmacological activities. The plant extract is used as emmenogogue, sudorific, carminative, diuretic, antiseptic, anti-inflammatory, and digestive. It also has abortifacient activity.[1] The plant and essential oil also have antifungal, antiviral, and antibacterial activity which are proved in experimental study. Berries of plant shows cytotoxic and hypolipidemic activity proved experimentally.[2] In traditional medicine system, juniperus is used.[3,4] The genus consist of 75 varieties approximately depends on taxonomical features but taxonomist disagree on exact number of juniper varieties.[5,6]

The juniper berries are utilized in Turkish medicine as antiseptic, diuretic, and to treat gastrointestinal problems.[7] Anti-inflammatory activity has been experientially shown and from successive generations of European traditional medicine.[8,9] Conventionally, fruit of plant is utilized in therapy of Migraine, Rheumatic arthritis, and gout and also used as Anorexigenic agent, female contraceptive, and anti-diabetic agent in Native America.[10,11] Conventionally, juniper fruits are used internally as infusion for antiseptic effect, diuretic effect, and externally for dermatitis condition in Romania.[12] Aerial parts of plant were used for amenorrhea, leucorrhea, renal suppression, catarrh of bladder, albuminuria, and cystitis. Bark of shrub has also used in asthma, pulmonary blannorrhea, bladder affections, cough, skin diseases, Nephritic Dropsy especially in kids or children, gonorrhea, arthritis, respiratory affections, abdominal disorders, chronic pyelophritis, diabetes, etc. Fruits have antiseptic property and styptic property also utilized in treatment of infantile tuberculosis and piles.

The entire plant has proven to be beneficial in the therapy of inflammatory, diuretic, emmenagogue, urinary antiseptic, carminative, and digestive problems.[4,13,14] Other health effects in juniper plant are neuroprotective, hepatoprotective, and anti-fertility effect. Recent experimental studies demonstrated new pharmacological activities, namely, antimicrobial, hypolipidemic, anti-inflammatory, cytotoxic, antioxidant activity in essential oils, and extract of *Juniperus* plant.

Department of Pharmaceutics, Sandip Institute of Phamaceutical Sciences, Nashik, Maharashtra, India.

Corresponding Author: Mrunal Sanjiv Kapadnis, Department of Pharmaceutics, Sandip Institute of Phamaceutical Sciences, Nashik, Maharashtra, India. Email: mrunalkapadnis29@gmail.com

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Geographical Distribution

The *J. communis* evergreen aromatic plant or shrub extending from Europe and North America, to approximately 30_N latitude, also in Arctic region of Asia. From Kumaon westwards, at elevations of 1700–4200 m, it can be found in the Western Himalayas.[2,15] Juniper Family-Cupressaceae is mostly distributed throughout the cold and temperate region of North Hemisphere with some species extended toward south in Tropical Africa.[5,6] Of all the woody plants, this one has the broadest spread. Other common important species of *Juniperus* in Himalaya range include *Juniperus indica*, *Juniperus recurva*, and *Juniperus squamata*.[16,17]

Description

J. communis is a tiny evergreen aromatic shrub or tree with a variety of forms. The tree or shrub, which can raise to be 10 m tall or smaller, is a low-growing, prostate-spreading shrub that grows in exposed areas.

The fruits are berry-like cones that begin green and develop purplish black after 18 months, with a bluish waxy covering. The berries are spherical, with a diameter of 4–12 mm and three (sometimes six) fused fleshy scales bearing a single seed. When birds ingest the cones, they digest the mushy scale and excrete the hard seed.

It features three whorls of green needle-like leaves with a single white stomatal band on the internal surface. It is monoecious, having male, female cones on distinct plants that are pollinated by the wind.

The male cones are 2–3 mm long yellow in color and they fall quickly after pollen is discharged.[15] Oil glands are found on some species and are pressed close to the branchlets that are rounded or four-angled in nature. Female as well as male reproductive structures are born on different plants. The cones matures up to three seasons and carry one to 12 seeds, with the average being three [Tables 1-5].[18] The parts of *Juniperus* tree are mentioned in Figure.1.

Chemical Constituents

Juniper is store house of various chemical constituents having pharmacological action. It contains chemical constituents such as flavonoids, comarins, and volatile oils. Methanolic extract of plant give several labdone diterpenoids and diterpenes. The fruit berries contains essential oil (2.5% in dry fruit and 0.5% in fresh fruit) invert sugars (15–30%), resins (10%), catechin (3–5%), terpenic acid, wax, flavonoids, gums, tannins, organic acids, leucoanthocyanidins, Juniperine (bitter compound), Lignins, etc.[19-22]

The berries provide diterpene ketone, beta-sitosterol glucoside, 10-nonacosanol, and sugrol.[1] Monoterpenes, Diterpenes, and Sesquiterpenes of hydrocarbon are the most important terpenoids in essential oils, whereas their oxygenated derivatives are minor ingredients.[23,24]

Monoterpenoids made up 83% of the monoterpenoids in berry essential oil, with monoterpene hydrocarbons accounting for 69.4%. α-pinene, ß-myrcene, ß-pinene, limonene, and sabinene are the main monoterpene hydrocarbons that terpinen-4-ol, linalool, borneol, ß-citronellol, camphene hydrate, myretenol, etc., are the oxygenated monoterpene hydrocarbons.[25] Figures 2, 3, 4 and 5 shows structures of some of chemical constituent present in *Juniperus plant*. Despite monoterpene compounds' dominance in oils, there are variances in their quantitative composition due to factors such as fruit age, manufacturing method, geographical region, degree of ripeness, and so on. Due to origination region, differences such variation in composition of Juniper essential oils were reported in different regions in Europe and America. The pinenes were the main constituent mostly α-pinene varying in juniperus oil at different places; 27% in Greece;[26] 28.6–38.2% in Montenegro;[27] and 46.6% in Iran samples [Table 6].[3,28-35]

Table 1: Vernacular names

Languages	*Vernacular Names*
Sanskrit	Havusa, Matsyagandha
Assamese	Arar, Abahal, Habbul
Bengal	Hayusha
English	Juniper Berry, Common Juniper
Marathi	Hosh
Hindi	Havuber, Havubair
Kannada	Padma Beeja
Gujrati	Palash
Punjabi	Havulber
Telugu	Hapusha
Urdu	Abhal, Aarar, Haauber, Hubb-ularar

Table 2: Scientific classifications

Kingdom	*Plantae*
Clade	Tracheophytes
Division	*Pinophyta*
Class	*Pinopsida*
Order	*Pinales*
Family	Cupressaceae
Genus	*Juniperus*
Division	*Juniperus* division
Subdivision	*Juniperus* subdivision
Binomial name	*Juniperus communis*

Dosage

Dried fruit: 2–6 g of powder [API, Vol. III.].[1]

Pharmacological Activity

Antioxidant Activity

The (ethanolic and aqueous) extracts show an effective antioxidant activity at concentration of 20, 40, and 60 µg/mL.[36] Fruit extracts of Juniper have effective reducing, scavenging, and chelating activity in several scavenging experiments at these doses. Essential oils derived from the berries of various juniper species have also been shown to have antioxidant action.[37] The extract from fruit was equally effective at preventing linoleic acid emulsion peroxidation.

Anti-fertility Effect

J. communis extract has abortifacient effect as of antiprogestagenic activity.[38] The dose-dependent anti-implantation activity was reported by the hydroalcoholic fruit extract of juniper when it was given at rate of 300–500 Mg/Kg/Day of body weight by oral route from day 1 to day 7 of pregnancy.[44] When given on the 14th, 15th, also at 16 day of pregnancy, it demonstrated abortifacient effect at both dose levels. There has never been a case of teratogenicity linked to the administration of extract to pregnant animals.[39]

Antihyperlipidemic Activity

Methanolic extract significantly increases high-density lipoprotein (HDL) level in Streptozotocin (STZ) persuaded Diabetes in Rats in comparison to Glibenclamide.[14] The methanolic extract significantly reduces total cholesterol, triglyceride, very low-density lipoprotein (LDL), and LDL, with the elevation of HDL levels in a dose-dependent manner in diabetic rats.[40]

Antimalarial Activity

The essential oil gained from upper (aerial) parts of Juniper by hydrodistillation method exhibited anti-malarial action on *Plasmodium falciparum* species. The parasite's development was

Table 3: Species of *Juniper*

Biological name	*Vernacular names*	*Characteristics*	*Habitat (USDA: United State Growing Zone)*
Juniperus deppeana	Alligator Juniper Checkerbark juniper Oak barked juniper Thick barked juniper Western juniper Mountain cedar	1. Named for its unique bark resembles the rough, checkered skin 2. Depending on the growth environment	1.Central and Northern Mexico Southwestern U.S. 2. USDA Growing zone 7–9 3. Height – upto 60 feet 4. Sun Exposure –full sun
Juniperus californica	California juniper Desert white cedar	1. In southwest found as large shrub or plant 2. Scale like blue gray leaves and reddish brown cones 3. High tolerance to alkaline soils	1. Native area - Southwestern U.S. 2.USDA growing zone 8–10 3.Height - 10–15 feet 4.Sun Exposure –full sun
Juniperus chinensis	Chinese Juniper Hollywood juniper	1.When it reaches maturity, it takes on an intriguing twisted form that is ideal for use as a specimen plant	1.Native area - Japan and China 2.USDA growing zone4-9 3.Height –varies 4.Sun Exposure –full sun
Juniperus communis	Common juniper Dwarf juniper Prostrate juniper Mountain common juniper old firld common juniper ground juniper Creeping juniper carpet juniper	1. Grows in Acidic and Alkaline soil and adapting many locations like windy sites 2. Rare plant that has needle like leaves rather than scales	1. Native area – North America, Japan, Europe, North Asian region 2. USDA Growing Zone- 3 to 8 3. Height –varies 4. Sun Exposure –full sun
Juniperus horizontalis	Creeping Juniper Trailing juniper creeping Savin juniper	1. When the plants mature, the needle-like leaves turn into scales. The cones are bluish white berries with a (waxy) greasy coating	1.Native Area: Northern U.S., Canada, Alaska 2. USDA Growing Zones: 3 to 9 3. Height: 1 to 2 feet 4. Sun Exposure: full sun
Juniperus virginiana	Eastern Red Cedar	1.Is especially fragrant, used to repel insects 2.Upright shrub or tree along with dark blue green like scale like foliage 3.Bark – gray to reddish brown shreads in vertical strips	1.Native area – Eastern North America 2.USDA Growing Zone- 2 to 9 3.Height –30 to 40 feet 4.Sun Exposure – full sun
Juniperus exelsa	Greek Juniper	1. Grow beside the foul odor juniper (Juniperus foetidissima), a species of juniper 2. Similar in appearance 3. Greek juniper leaves are needles that mature into flatten scale as the tree grows 4. Trunk –upto 6feets in diameter 5. Cones on female plant are purple-blue berries	1.Native area – Eastern Mediterranean 2. USDA Growing Zone - 5–9 3. Height –20–65 feet 4. Sun Exposure – full sun
Juniperus monosperma	One-Seed Juniper Single seed juniper Cherrystone juniper	1. Larger shrub or tree on mature plants, the leaves are folded scales. Cones are dark blue berries with white coating 2. Bark – gray brown shedding in short verticle strips revealing scarlet wood beneath 3. Berries contain one seed	1. Native area –Southwestern U.S., Mexico 2. USDA Growing Zone – 3–7 3. Height –6 to 20 feet 4. Sun Exposure – full sun

(Contd...)

Table 3: *(Continued)*

Biological name	*Vernacular names*	*Characteristics*	*Habitat (USDA: United State Growing Zone)*
Juniperus scopulorum	Rocky Mountain Juniper Mountain red cedar Rocky mountain cedar Colorado red cedar	1. Closely related to eastern red cedar. 2. Tree of medium size that grows in a pyramidal shape 3. Cones are recognisable blue green berries with waxy white covering found in many junipers, and mature tree has scale-like leaves 4. One of the species that is vulnerable to cedar apple rust disease	1. Native area – Western North American Rocky Mountain Regions 2. USDA Growing Zone-3–8 3. Height –5 to15 feet may grow to60 feet in the wild 4.Sun Exposure – full sun
Juniperus osteosperma or Juniperus. utahensis	Utah Juniper Bigberry juniper (Western U.S.) Desert juniper (Western U.S.)	1. Cidar city, Utah, cedar disrupt national memorial got their names as of these tree 2. It also grows in other areas of western U.S. and Arizona 3. A typical juniper is a tree has foliage which is lighter yellow green 4. Foliage is scale like and cone is bluish brown 5. The stems extremely thick and the bark is gray brown	1. Native area – western U.S. 2.USDA Growing Zone- 3–7 3. Height – 10–20 feet occasionally 25 feet 4. Sun Exposure – full sun

Table 4: Subspecies of Juniper

Species Names	*Distinguishing Characteristics*
Subspecies *Communis* (common juniper)	Erect, small shrub or plant Leaves 8–20 mm Cones small 5–8 mm shorter than leaves Found in temperate climate, Low to moderate Altitude
Subspecies *Communis* var. *communis*	Europe, most of northern Asia
Subspecies *Communis* var. Depressa	Northern America, Sierra, Nevada in California
Subspecies *Communis* var. *Hemispherica* (*J. presl* and *C. Persl*) Parl	Mediterranean mountains
Subspecies *Communis* var. Nipponica (Maxim) E.H.Wilson Japan	Japan
Subspecies *Communis* Alpine (Suter) Celak Alpine juniper	Usually a ground-hugging shrub that is prostrate. Leaves short 3–8 mm Cones often larger 7–12 mm longer than leaves Discovered in higher Altitude Alpine Zone, In temperate areas and sub-arctic areas
Subspecies Alpine var. Alpine	Greenland Europe Asia
Subspecies Alpine var. *Megistocarpa* (fernald and H.S. John)	Eastern Canada (doubtfully distinct from var. alpine)
Subspecies Alpine var. Jackii (Rehder)	Western north America (doubtfully distinct from var. alpine)

Table 5: Conventional uses of Juniper

Part	*Traditional use*
Aerial parts	Amenorrhea, Catarrh of the Bladder, Leucorrhea, Renal suppression, Albuminuria, Cystitis (Acute and chronic)[4,14]
Fruit	Piles, Stimulant, Disinfectant, Chronic Bright's disease, Styptic, Migraine, Dropsy, Carminative, Rheumatic and painful swelling, Antiseptic, Infantile Tuberculosis[19]
Bark	Sudorific, Skin and Respiratory affections, Chronic Pyelonephritis, Nephritic dropsy of children, Gonorrhea, Arthritis, Diabetes, Bladder affections, Pulmonary Blennorrhea, Cough, Asthma and Abdominal disorders[13,19]
Berries	Carminative, urinary antiseptic, diuretic, emmenagogue, sudorific, digestive, anti-inflammatory

Table 6: Chemical constituents present in juniper plant

Flavonoids	1. Berries: Luteolin, Apigenin, Rutin, Scutellarein, Quercitrin, Quercetin-3-O-arabinosyl-glucoside, Bilobetin, Quercetin-3-o-rhamnoside, Nepetin, Amentoflavone [Figures 2 and 3][29-34] 2. Leaves: Cupressuflavone, Hinokiflavone, Biflavones, Isocryptomerin, Amentoflavone, and Sciadopitysin. 3. Seeds: Haemagglutinin[1]
Coumarins	Umbelliferone [Figure 5][30]
Volatile oils	The juniperus berry oil: Monoterpene Hydrocarbon: β-pinene (5.0%), α-pinene (51.4%), Sabinene (5.8%), Myrcene (8.3%) Limonene (5.1%)[35] Seeds and Fruit: Camphene, Pectins, Malic acid, Glycolic acid, β-Pinene, cyclohexitol, Formic acid, d-α-Pinene, Terpene, Fermentable sugars, proteins, wax, Ascorbic acid, Gum, Camphor, Juniper, Junene hydrocarbon, Cadinene, Acetic Acid [Figure 4][24]

50% inhibited (*in vitro*) at two concentrations ranging from 150 µg/mL to 1 mg/mL, and the effect was observed after 24 and 72 h. The oils of *Myrtus communis*, *Rosmarinus officinalis*, at doses ranging

from 150 to 270 µg/mL, were shown to be the most effective against *P. falciparum*.[41]

Antimicrobial Activity

J. communis berries were shown to exhibit antibacterial activity, and their volatile oils were studied using GC-FID and GC-MS.

Three-part DMF solution varied essential oil concentrations (1, 3, and 5 mg/mL) was made, which were then placed to a disk for measuring the diameter of the inhibitory zone surrounding the compact disk. The chromatographic examination of *J. communis* essential oil revealed 41 constituents, amounting for 96% of the entire oil composition.

Juniper essential oil showed antimicrobial activity against *Acinetobacter* spp., *Alternaria* spp., *Aspergillus nidulans*, *Aspergillus niger*, *Bacillus cereus*, *Campylobacter jejuni, Candida albicans, Corynebacterium* spp., *Escherichia coli*, *Haemophillus influnzae*, *Klebsiella pneumonia*, *Listeria monocytogenes*, *Mycobacterium tuberculosis, Proteus mirabilis*, *Streptococcus agalactiae*, *Salmonella enteritidis*, *Staphylococcus epidermidis*, *Shigella flexneri*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*, as comparison to Ampicillin and Erythromycin.[13,28,42-46]

Antinociceptive Activity

The (methanol and aqueous) extracts of five juniper trees cultivated in Turkey were assessed for antinociceptive activity *in vivo* utilizing p-benzoquinone induced abdominal contractions and hot plate tests, as well as anti-inflammatory activity using Carrageenan and PEG2 produced hind paw edema models at a dose of 100 mg/kg/day of body weight.[47]

Antiparasitic Activity

In *Schistosoma mansoni* sambon worms as well as *Biomphalaria alexandrina* [Ehrenberg] snails, *J. communis* (methanolic) extract displayed schistosomicidal and molluscicidal activity.[48]

Antiurolithiatic Effects

Fraction of *J. communis* fruit extract reduces the weight of the stones dry powder provided from human kidneys composed of calcium oxalate, calcium hydrogen phosphate, magnesium ammonium phosphate, and ammonium urate *in vitro* study.[49]

Anticataleptic Activity

In anticataleptic study, the effect of (methanolic) extract of juniper leaves (MEJC) studied on reserpine induced cataleptic rats. Reserpine at 2.5 mg/kg concentration was given by intraperitoneal route to induce catalepsy. The efficacy of the (methanolic) extract at 100 mg/kg and 200 mg/kg intraperitoneal against reserpine-induced catalepsy in rats was tested. When compared to reserpine-treated rats, the MEJC extract significantly reduced catalepsy ($P < 0.001$); the highest level of reduction was observed at a dosage of 200 mg/kg.[50]

Analgesic Activity

Methanolic extract showed analgesic activity in the formalin test, writhing caused by acetic acid and tail-flick test in comparison to standard acetyl salicylic acid in a dose-dependent manner. The analgesic efficacy of the methanolic extract was tested at doses of (100 mg/kg and 200 mg/kg). The standard was Acetyl Salicylic Acid (100 mg/kg). Different procedures, such as the formalin test, acetic acid induced writhing, and tail flick examination, were used to analyze the extract *in vivo*. When compared to aspirin ($P < 0.01$), *J. communis* gave a substantial ($P < 0.01$) and dose-dependent effect on suppression of writhing response examination and dose-dependent inhibition in the later stages. The central analgesic efficacy is confirmed by the inhibition naloxone's effect at concentration 2 mg/kg given by Intraperitoneal route.[51]

Antiarthritis Activity

A biologically active compound Amento flavone taken from the plant *J. communis* showed a positive result in controlling inflammation in Arthritis induced by Freund's adjuvant in Rats.[52] The formation of [12[S]-hydroxy-5,8,10,14-eicosatetraenoic acid] was significantly inhibited by methylene chloride extracts of *Lignum juniperi*, *Juniperi pseudo-fructus*, and the ethyl acetate extract of *Juniperi pseudofructus*.[53] Ecosatetranoic acid which is inhibited by methylene chloride extract plays important role in cell growth, but also it has inflammatory activity and role in autoimmune disorder like arthritis.[54]

Antibacterial Activity

When compared to standard antibiotics, methanolic, ethanolic, chloroform, and hexane extracts of leaves demonstrated antibacterial action against pathogenic bacteria which are resistant to multiple drugs named as *Bacillus subtilis*, *Xanthomonas phaseoli*, *Erwinia chrysanthemi, Agrobacterium tumefaciens,* as well as *E. coli* using the disk diffusion method as compared to standard antibiotics (ampicillin 10 mcg and erythromycin 15 mcg) used as positive control.[44]

Antidiabetic Activity

In diabetic rats caused by STZ nicotinamide, *J. communis* was found to have antidiabetic properties. Except for the group that got (glibenclamide 10 mg/Kg), *J. communis* (methanolic extract, 100 mg/kg and 200 mg/Kg p.o.) was given. On the 21st day, biochemical measurements and (FBGL) fasting blood glucose levels were taken. In diabetic rats, the methanolic extract of *J. communis* produced a significant ($P < 0.01$) reduction in glucose levels in blood. The levels of SGPT and SGOT were significantly reduced by the common medication glibenclamide. *J. communis* methanolic extract demonstrated substantial anti-diabetic action.[14,55]

Antifungal Activity

As of the large amount of oxygenated monoterpenes, the essential oil (0.1–0.3% yield) acquired by aerial portions of *J. communis* by hydrodistillation showed antifungal (*in vitro*) action against two fungus, *Rhizopus stolonifer and Rhizoctonia solani*. (0.704mg/mL and EC50: 0.554).[53,56]

Anti-inflammatory Activity

Using isolated cell, enzymatic test, the anti-inflammatory efficacy of *J. communis* fruit was determined. Aqueous extract of the shrub or plant showed varying level of anti-inflammatory activity at 0.25 mg/mL in Platelet Activating Factor (PAF) test and at 0.2 mg/mL in Prostaglandin test. Prostaglandin inhibition was 55% and PAF exocytosis inhibition was 78% *in J. communis*. The PAF test was determined by generating elastase exocytosis. Thin-layer chromatography was used to examine all plant extracts, which were eluted with ethyl acetate/methanol/water.[9]

Antiulcer Activity

The leaf extract of *Juniperus* which was crude at doses of 50 mg and 100 mg/Kg (intra-peritoneal) significantly inhibited serotonin, indomethacin, alcohol, aspirin, and stress-induced gastric ulcerations in rats and duodenal lesions induced by Histamine in guinea pigs. *J. communis* leaf extract significantly increased healing rate of ulcer induced by acetic acid in rats. The results matched those of the commonly prescribed medication ranitidine. The extract dramatically reduced the amount and overall gastric juice acidity, but had no effect on pH or peptic activity, according to biochemical analyses.[57]

Figure 1: (Parts of *J.communis* A: Leaves, B: Bark, C: Berries)

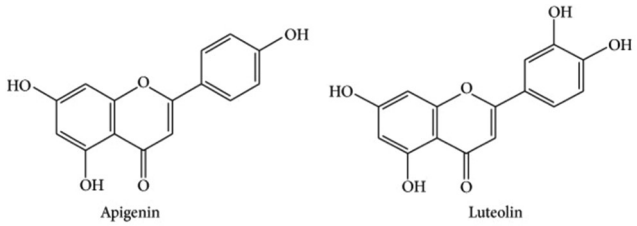

Figure 2: Chemical structures

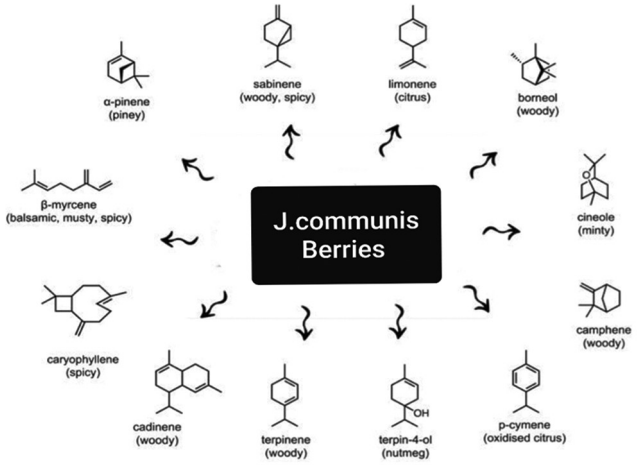

Figure 3: Chemical structures

Gastrointestinal Activity

J. communis has been described to be beneficial in relieving certain gastrointestinal disorders as of its carminative, anti-bacterial, digestive, and anti-spasmodic action.[4,13,14] Champing of berries is helpful in treating gum with infection and inflammation due to antiseptic activity and anti-inflammatory activity. The berries being bitter have digestive action. Antipasmodic effect of Juniper is as of its carminative, analgesic, and anti-inflammatory effect.

Hepatoprotective Activity

J. communis's hepatoprotective effect was tested in a carbon tetrachloride-induced hepatotoxic model. Hepatic damage biomarkers such as aspartate and alanine, aminotransferase, alkaline phosphatase, and bilirubin were reduced when aqueous or ethanolic extracts of berries of Juniper were given.[58] In paracetamol provoked liver injury in rats, the extract of ethyl acetate of juniper leaves was examined for its hepatoprotective activity. When compared to hepatotoxic rats which are untreated, this fraction treated hepatotoxic rats had significantly lower levels of serum aspartate, direct bilirubin, alkaline phosphatase, and alanine aminotransferase.[59]

By taking *J. communis* along with an ethanolic (fruit) extract of *Solanum xanthocarum* every day for 14 days course, the liver damage produced by azithromycin and paracetamol co-administration was considerably reduced. The long-term treatment not only restored biochemical markers but also reversed histological abnormalities in rats' liver tissue.[60]

Insecticidal Activity and Insect Repellent Activity

Each of the essential oils extracted by semi commercial steam distillation of *J. communis* (male and female) *Juniperus oxcedrus* (male) and *Juniperus sibirica* (female, Male) were tested for repellent activity against *Rhopalosiphum padi* and *Sitobion avenae*. The repellence effect of essential oils of plant was analyzed using Petri dish assay.[61]

The repellent effect was observed and recorded with 0%, 1%, 2.5%, and 5% concentrations after 24 h. Essential oils concentration in the solution of 1%, 2.5%, and 5%, essential oils displayed substantial insecticidal and repellant activity against two aphid species, (*R. padi* and *S. avenae*) which are bird Cherry oat aphid and English grain aphid.

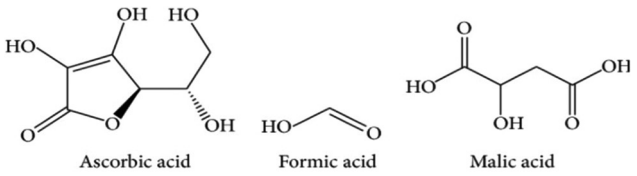

Figure 4: Chemical structures

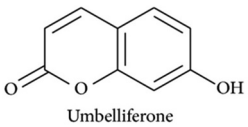

Figure 5: Chemical structure

Most of juniper essential oils were tested against the pathogens *Cylindrocarpon pauciseptatum*, *Colletotrichum* spp., *Fusarium* spp., *Rhizoctonia solani*, especially *Juniperus pygmea* (male) and *J.sibirica* (Female). These essential oils have the potential to be employed in the creation of biopesticide products as a replacement for traditional synthetic pesticides.

Neuroprotective Activity

Methanolic extract of leaves of *J. communis* reduced catalepsy significantly in reserpine and chlorpromazine induced Parkinson's disease models in animals. The neuroprotective action was assessed using behavior characteristics such as muscle rigidity [rot rod test], locomotor activity [actophotometer], biochemical parameters [TBARS, GSH, total protein, Nitrate], and catalepsy [bar test], in rats brain. Such data showed a therapeutic action against Parkinson's disease.[44]

Tyrosinase Suppressive Activity

The *J. communis* methanolic extract containing Hypolaetin 7-O-β- xylopyranoside effectively suppressed mushroom tyrosinase activity and α-MSH-induced melanin synthesis.[62]

Conclusion

The literature review concluded that *J. communis* L. is medicinally important plant or shrub due to its various pharmacological activities. Several important chemical compounds in plants are responsible for curing a variety of ailments. Additional evaluations must be carried out to confirm its medicinal uses for developing formulation containing natural drug to avoid adverse effect of synthetic drug which is beneficial for mankind.

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