International Journal of Chemical and Biochemical Sciences
(ISSN 2226-9614)

Journal Home page: www.iscientific.org/Journal.html

Juniperus communis: Biological Activities and Therapeutic Potentials of a Medicinal Plant – A Comprehensive Study

Ayesha Tahir[1], Muhammad Idrees Jilani[1,2], Rasheed Ahmad Khera[1] and Farwa Nadeem[1]*

[1]Department of Chemistry, University of Agriculture, Faisalabad-38040-Pakistan and [2]School of Chemistry and Molecular Biosciences, University of Queensland, Australia

Abstract

Juniper (*Juniperus communis*) is a smaller tree or a shrub belonging to genus Juniperus and family Cupressaceae. This family includes 30 genera and almost 130–140 species that are subdioecious, monoecious or dioecious shrubs and trees. Most of the species belonging to this family are important source of timber while some are significant as horticulture crop. *Juniperus communis* and its various varieties are found in northern Europe, North America, Canada, Greenland, Iceland and far western North America. *Juniperus communis* is a horizontally spreading smaller shrubs or trees that can attain the height of 50 cm and diameter less than 3 m. It has evergreen, small and narrow leaves with three whorls having 5 to 15 mm length, upper surface of which is curved and whitish in colour. Medicinal properties and specific flavour of this plant is mainly associated with its volatile oil components. Juniper has various types of chemical constituents such as flavonoids and coumarins which include luteolin, apigenin, quercetin-3-O-arabinosyl-glucoside, quercetin-3-o-rhamnosidequercitrin, scutellarein, rutin, nepetin, amentoflavone and bilobetin. Seeds and fruits of Juniper are known to contain d-α-pinene, pectins, glycolic acid, camphene, formic acid, acetic acid, malic acid cyclohexitol, terpene, proteins, fermentable, ascorbic acid, dihydrojunene, β-pinene, hydrocarbon-junene, gum, sugars, wax, cadinene, juniper and camphor. Juniper is preferably used to improve digestion and to treat stomach ulcers along with intestinal disorders, loss of hunger, worms, bloating and gastrointestinal infections due to excellent anti-oxidant, anti-septic, anti-inflammatory and anti-diabetic potentials.

Key words: *Juniperus communis*, coumarins, luteolin, quercetin-3-O-arabinosyl-glucoside, rutin, glycolic acid, dihydrojunene, anti-oxidant, anti-inflammatory, anti-diabetic

Full length article **Corresponding Author*, e-mail: farwa668@gmail.com

1. Botany

1.1 Introduction

Juniperus communis is a shrub or small tree in the genus *Juniperus* and it is a member of family Cupressaceae. This family includes 30 genera, consisting of 130–140 species that are subdioecious, monoecious or (hardly ever) dioecious shrubs and trees. Many species of this family are important for timber sources and some are also significant in horticulture. It has the prevalent geological variety of woody plants [1]. Juniper is only specie in its genus that is found in both hemispheres. Fargon acknowledged the *Juniperus communis* and its varieties in northern Europe, North America, Canada, Greenland, Iceland and far western North America [2]. *Juniperus communis* is mostly found in dry and rocky areas. Plants are considered to be very crucial for treatment of many diseases since old ages and till now a lot of plant species have reported to be very useful for different medicinal activities [3-4]. Juniper is an important specie for making folk medication [5-6]. *Juniperus communis* is used as diuretic as it has anti-inflammatory characteristics. It is an important anti-bacterial [7], anti-oxidant [8], hepato-protective, neuro-protective, anti-fungal and anti-cataleptic drug.

Essential oil of juniper berries have its applications in various fields as this oil acts as anti-microbial element and used in preservation of food and preparation of medicinal formulations and pharmaceutical products. Juniper plant causes digestive glands to stimulate and has anti-septic outcome. Juniper berries have bitter taste so help in causing the appetite. Fruits are useful in strengthening the stomach and gut. Juniper fruits contain natural sugars, resin, essential oils, tannin and acids and also act as flavoring agent in different foods. Leaves and stem of junipers give an essence on distillation that is used in manufacturing of drugs [9]. Essential oil of juniper berries have its applications in various fields as this oil acts as anti-microbial element and used in preservation of food articles and medicinal compounds. Juniper seed oil is reported to be used in quality

food which causes increase in weight and appreciable decrease in body fats. Tucker reported that this kind of supplementation is the major reason of long life and lower mortality rates [9].

1.2 History/Origin

Juniperus is an old Latin name for small evergreen shrubs or trees. The term "genvier" is also used for "juniper", from which the term "gin" is derived. Gin is a vast class of spirits that gets its flavour from *Juniperus communis* [10]. Since prehistoric times, juniper has been used by every civilization for ritual and sacramental cleansing, particularly in temples. It was burned to avoid from evil spirits and the plague. It is extensively used by native cultures and is a result of scientific studies that support its historical value. Egyptian papyri contain the recipes of many medicines, also including the treatment of tapeworm. Five parts juniper essential oil and five parts of white oil has to take for a day. Approximately 200 years before in Europe, it was used by sick as well as healthy persons to maintain their health and to make their bodies stronger. In central European indigenous system of medication, this oil was extracted by juniper berries and considered to be a good source of treatment for intestinal infections, typhoid, cholera, tapeworm, diarrhoea and other poverty correlated disorders.

In North American tribes, Malecite and Micmac which are local to Canadian Maritime Provinces, utilized juniper for lesion, tuberculosis, sprains, burning and ulcers (several internal and external). They believed that the juniper made the body stronger and capable of fighting against diseases. Natives of America generally used the juniper by drying and crushing them into a food that was produced into fried and patty. The taste might not be too good but it kept the body healthy and could easily be digested, as well as it's a good diuretic [10]. The natives of American tribe Zuni calmed down their muscles before delivery by making a tea from cooked branches that also helped speedy recovery after childbirth. Some tribes burned the stems and branches in the place of the mother who had just undergone the delivery process. They also take this tea to cure the swelled stomach and to relax their muscles. The Shoshone treated the bladder and kidney disorders from the tea obtained from juniper berries while the Canadian natives used the juniper roots to make tea for same diseases. In 1840s, the Asiatic cholera became plague in Lakotas and caused many deaths and spread terror in others. Red cloud did many cures for this epidemic, including the extraction of leaves of juniper which was used for taking bath and drinking too.

1.3 Demography/Location

Juniperus communis is a plant found in the soil that is deficient in nutrients and severe atmosphere. In north and centre of Europe, it develops at lower heights in grazing lands, clear cuts and deserted fields. Moreover, it is also found on high altitudes in grasslands present on slopes of Euro Siberian and Mediterranean mountains. Although different types and sub-species of juniper have been reported, genetic basis of several ecospecies are inadequately recorded [11]. This is a wind pollinated and dioecious specie. The females develop the cones in every spring that grow into larger globular structures, named as galbulae [12-13]. Cones mature completely after three years in autumn; become grey coloured, with two to four seeds in a cone having 6.5 cm diameters. A few seeds ended prematurely even inside the well matured cones. Immature seeds exhibit embryo that is not filled with fruit flesh while the embryo of healthy seeds are fatty, white and are filled with fruit flesh. Apparently, filled seeds are same as aborted seeds, because testa of seeds grows in the ordinary way regardless of the embryo miscarriage [14]. Juniper cones are affected by some kinds of insect species [12-15] however seeds are predominantly victimized by *Megastigmus bipunctatus Swed* [14]. This wasp is found in Asia and Europe that particularly affect *Juniper communis* and *Juniper sabina* species [16] and is specific for its predation that makes it different from other predacious species [17]. The ecological choice of many species is dependent on weather conditions. Low temperature at northern boundary of northern hemisphere restricts the environmental feasibility of these plants in this range, whereas at southern boundary, water accessibility is major restraining aspect [18]. These physical conditions can have distinct effects by increasing transience of specie, particularly those in infantile stages and also by decreasing the reproductive capability because of serious drop in the reproduction if mature and filled embryo [19].

1.4 Botany, Morphology and Ecology

Juniperus communis is a horizontally spreading small shrubs or trees that can be upto 50 cm long and less than 3 m in diameter. It has evergreen, small, narrow leaves with three whorls having 5 to 15 mm length, upper surface of which is curved and whitish in colour. Male cones present at the edge of branches are tiny in size while that of female are fleshy and bluish in colour. At the termination of summer, when branches have attained their maximum lengths, florets of flowers are formed. At the termination of spring and start of summer, flowers do the pollination. In second year, plants do the fertilization and develop cones during third year [20]. Many animals are dependent on juniper for browsing and grazing, however these shrubs are not very tasty to eat due to presence of oils in the wood, needles and cones [21]. Browsing is more common in winter due to shortage of other foodstuff for sheep [22] as well as for deer [23]. Prostrated juniper looks like to be at risk of browsing or grazing owing to their lower heights that are accessible for most of the animals. Due to constant feeding by sheep, the height of the junipers would be restricted to small shrubs. These shrubs develop gradually only a few branches could be able to attain the height that is not suitable for grazing individuals. Even the plants which are in the range of grazing animals may gradually extinct. Rabbits

are severe trouble to many sites since 1980s causing a big destruction however they are source of bared land where junipers can grow. Juniper cones, seedling and wood are constantly browsed and in this way the damaged plants may assist the access of fungus. On the other hand, the resin which discharge due to injury is considered to be essential for treating the infections [24].

2. Chemistry

Medicinal properties and specific flavour of this plant is mainly associated with its volatile oil components. Although all the organs of this plant have essential oils, but berries needles and their branches (*Juniper foliage*) and mature female cones (*Juniper Fructus*) are rich source of oils. The amount of essential oil present in berries is 0.2-3.42% that depends upon altitude, geographic location, degree of ripeness and some other factors.

2.1 Chemical Composition

Juniper has various types of chemical constituents e.g. flavonoids, volatile oil and coumarins. Flavanoids present in berries are apigenin, luteolin, quercetin-3-O-arabinosyl-glucoside, quercetin-3-o-rhamnosidequercitrin, scutellarein, rutin, nepetin, amentoflavone and bilobetin [25]. Leaves contain hinokiflavone, cupressuflavone, isocryptomerin amentoflavone, biflavones and sciadopitysin and seeds contain haemagglutinin. Moreover, juniper also contains some labdane diterpenes and amp; diterpenoids [26]. Juniper berry oil is largely comprised of monoterpene hydrocarbons such as α-pinene and β-pinene, myrcene, sabinene and limonene [8]. Seeds and fruits of plant contain d-α-pinene, pectins, glycolic acid, camphene, formic acid, acetic acid, malic acid, cyclohexitol, terpene, fermentable, proteins, ascorbic acid, dihydrojunene, β-pinene, hydrocarbon-junene, gum, sugars, wax, cadinene, juniper and camphor [27]. Umbelliferone are also present in some parts of this plant [28]. They contain diterpenes, isocupressic acid, imbricatolic acid, aryltetralin, Junicedral, trans-communic acid and lignan deoxypodophyllotoxin [5]. Three more diterpene acids are identified that are as follows: (i) 15-dien-18-oic acid (ii) 7-oxo-13-epi-pimara-8,7-α-hydroxysandaracopimaric acid [29].

2.2 Phytochemistry

Studies reported that about 42 compounds were recognized as a constituent of juniper oil. Out of these forty two, approximately twelve are monoterpenes hydrocarbons eight are oxygenated sesquiterpenes, two are esters and six are sesquiterpenes. Monoterpenes has prominent amount in all the oils and is dominant than others. It is about 85 percent of total oil constituents. Only 3 to 17% of the total monoterpene is oxygenated monoterpene while about 70 to 90% is monoterpene hydrocarbons. Sesquiterpenes have a modest part that is from 0.5 to 5%. The esters that are present include terpenyl acetate and isononyl acetate that ranges between 0 to 4%. Diterpenes are present only in one component that is abietadiene and it is just 0.32%. The amount of main constituents of oils ranges as following: α-pinene is present between 58.6 and 77.3%, δ-3-carene ranges from 0 to 10% and trance amount of vebenol is also present that is less than 5.2% and the amount of camphene range between 0.6 to 9.3%. Pinene is found in all juniper essential oils [30].

3. Post-Harvesting Technology

Collecting ripened fruit, during second year, at favourable time, decrease probability of undeveloped seed. Ripened fruits are dropped from plant very easily even with a little activity. Motion of fingers causes them to remove from branches. The comfort of collection of fruits depends on ripeness and temperature. By decreasing the quantity of un-ripened fruits, maintenance period and the standard of product considerably increases. The state and perseverance of fruit is regularly observed to reduce the depletion to animals and birds. It is best to process the fruit immediately after collection; however it can also be preserved for some months providing appropriate atmosphere. Juniper can be kept in paper bags with low temperature of about 1.1°C having more moisture. The external coating of the fruit must be desiccated before storing it to avoid the molding. The damage causing activities like overloaded canisters or packed sacks should be avoided to regulate the air circulation in the fruits. The desiccated fruits are soaked in water to reduce the softness of skin a week before the processing [31].

3.1 Processing

Juniper is generally processed to get rid of outer layer and fleshy part of the seed. Juniper fruits have rough covering and resinous flesh which cause the difficulty in cleaning. Processing is done in the macerators which have flat walls that reduce the harm to the seed of plant during softening process. In this case, the harsh walls of macerator are not adequately harsh to eradicate the coating and fleshy part of seed. Different materials like rubber or sandpaper are used on the inner wall of macerator to increase the harshness of walls. At Bridger Plant Material Centre, two kinds of screens were used for this purpose: heavy weight inflated steel can be used for greenhouse practices and a lightweight welded cable. The inflated steel material due to its vigorous profile, readily remove the fleshy part however, it seemed to injure the seed testa such that this was not considered to be very useful but it can be used for the small period of time and after that the coating is removed to prevent the seed from damage. This type of screen improved germination process by breaking or scratching the seed coat completely making it porous to water and gaseous material [31].

After the removal of fleshy part and outer skin of seed, it is required to lessen the adhesiveness of leftover materials. To achieve it, a citrus containing cleaner is applied on slurry. In this way, the cleaning time as well the worth of the product is improved. Fruits that are rich in resin need extra rinsing, cleansing and maceration. The stickiness can be checked by pressing the seed with hands and letting the seed drop back in the macerator. Stickiness can be felt

on empty hands. Then seeds are washed again and again with cleaner so that the immature and undeveloped seeds are floated out and are separated. The cleaner is diluted with 50% water to make it cheaper. Use of the screen and cleaner significantly reduces the need of water that was required to wash out the slurry of seed in the macerator. Additionally, it also improves the seed processing as well quantity of cleaner. After the washing process, the seed is desiccated with kraft paper in a hot and arid place for about forty eight hours. Then seed is processed into a cleaning mill to get rid of useless material and unfilled seeds.

3.2 Value Addition

The extract from the branches of juniper is dandruff killing so it can be used as shampoo [32]. The essential oil that is extracted from this fruit is very useful for production of perfumes and fragrances [33]. In the countries with high temperature, a resin is released from any wound or cut in the stem of tree that is used for the formation of white coloured paints [34-35]. Trunks can be placed for one time utilization in the rooms for enhancing the sweetness of the fragrance of the rooms [36]. Complete plant is used for fragrance by burning just like incense and is also used as pesticide [37-38]. It has also been used to clean the air as well as to clear the infections in the periods of epidemics [36]. Its barks are used for making ropes, flammable materials like wood and paper and lighting of fire [32]. Prostrate is also used for many purposes [39].

4. Uses

Juniper shrubs and trees are very beneficial for human beings as well for animals. The junipers are collected in winter when they are completely developed and are used after drying. Its fruit is fleshy and pulpy which is edible [40]. Juniper fruit is also used to produce flavors in different meals and dishes. It is also an important element of gin, a spirit that derives its flavour from juniper [41]. It can also be used in place of pepper [41]. The cooked seeds can be used in place of coffee [42]. Boiled branches and leaves are used to make the tea [43]. Juniper berries are also used to make tea which has flavour of gin. It has many medicinal uses too as it improves the digestion, remove the extra water from the body and also help in detoxification of body. It is very helpful in arthritis.

4.1 General Uses

Juniper is used for landscape purposes. It is a very famous ornamental plant and is attracted by cultivars for its various uses in landscape [44]. Juniper is used for improvement of digestion process. Few drops of its essential oil are taken for this purpose. It calms down the convulsions of intestine as well as help in the detoxification of stomach. It is also helpful for stomach ulcers. Ingested juniper helps against the stomach swelling and acidity. It is also useful for intestinal disorders, loss of hunger, worms, bloating and numerous others gastro-intestinal infections. Juniper is applied on skin to cure the skin diseases and conditions. It is utilized for the treatment of skin problems like skin spots, pimples, warts, player's foot and psoriasis. Oil that is extracted from the wood of the juniper tree is specifically useful in the curation of psoriasis. Furthermore, anti-microbial activity of juniper makes it helpful in skin injuries and snakebites [45]. Essential oil of the junipers makes the blood circulation better by detoxifying the blood. This property of juniper makes it helpful in the treatment of arthritis and gout, both of these results due to disturbed blood circulation [46].

Juniper essential oil is diuretic and improves the urination. It promotes the regularity as well as volume of urination. In this way, it is valuable for the patients suffering by the presence of extra water in the body and inflammation because of renal failure. It is also taken for the purpose of weight loss because with the removal of water, some amount of fats is also removed from the body. This nature of juniper essential oil makes it advantageous for the reduction of blood pressure due to removal of spare salts from the body [47]. Juniper extract is used for arthritis. Massage of its oil is done to treat the swelling and pain of joints. It works rapidly due to its soothing effect. It is also helpful in muscle spasm and cramps for this activity. It is very good for aromatherapy for the release of stress and anxiety. It relaxes the tired body due to its magnificent aroma [48].

4.2 Pharmacological Uses

Juniperus communis is a very important plant owing to its unique pharmacological activities. It has magnificent medicinal properties that make it very useful in this field. It has wonderful healing effect that makes it helpful for skin problems. It is famous for its anti-biotic, anti-septic and anti-microbial potentials. Its essential oil is very useful anti-oxidant that helps against free radicals. It works as insulin against diabetes so it is anti-diabetic too.

4.2.1 Anti-Oxidant Activity

Juniper communis acts as anti-oxidant and reported to have significant anti-oxidant activities. It scavenges the ABTS radical, DPPH, hydroxyl radical and superoxide radicals. This effect of Juniperus oil was confirmed by probability of inhibiting the oxidation reactions in yeast cells through increasing the action of enzymes. Anti-oxidants protect the body from various diseases as they help the body to get relief from the stress which is caused by the presence of a number of free radicals in our body [8]. Juniper consists of polyphenolic compounds called flavonoids or bioflavonoids. These are the compounds that make any fruit to show anti-oxidant activity. According to one report, particularly, the juniper has more than eighty different anti-oxidant compounds that are usually found in ripened fruits as compared to unripened fruits [49].

4.2.2 Anti-Septic Activity

Juniper communis also shows the anti-septic activity. Due to this aspect of juniper essential oil, it acts as the cleaning element. It has very remarkable effects on different fungi and bacteria. So they can be used against the skin problems and respiratory disorders. The juniper oil

from the upper parts of the plants was tested against fungus and as a result, it was appeared to be the strong anti-fungal in nature. The anti-fungal activity of juniper is actually because of occurrence of high quantity of oxygenated monoterpenes [50]. *Juniper communis* effectively fight against the fungus candida which is responsible for infection with too much side effects [7]. Extract from the juniper leaves was used against the different drug resistant bacteria and it was concluded that juniper leave extract was useful against pathogenic bacteria. In this way, it works for the treatment of bacterial infection of body [51].

4.2.3 Anti-Inflammatory Activity

Juniperus communis also acts as anti-inflammatory agent and is used in skin protection. Juniper essential oil contains α-pinene as a main active compound in inflamed human fibroblasts. It also represents the efficient anti-proliferative action that retards the abnormal production of cells in the body. Furthermore, juniper essential oil remarkably prevents the tissues from remodelling [52].

4.2.4 Anti-Diabetic Activity

The juniper oil enhances the sensitivity of insulin and marginal usage of glucose. Juniper can improve the production of insulin through pancreas which is a gland that secretes the insulin and glucose. *Juniper communis* was reported to show activity against diabetes in the rats that are induced with streptozotocin niconamide. Blood glucose level was checked on twenty first day. A significant reduction was seen in glucose level of blood. The experiment was concluded after 24 days and it resulted that juniper is very beneficial for diabetes and work as a substitute of insulin in blood circulation. The juniper extract with methanol was used and proved to be effective in normalising the high blood glucose level. Juniper essential oil also appeared to be effective for controlling the quantity of malondialdehyde that is secreted by animal bodies [53].

5. Summary

Juniperus communis is a coniferous small tree or shrub that belongs to family Cupressaceae. It is commonly known as juniper. It has been used as flavoring agent since ancient ages. For thousands of years, it has been used for many domestic and commercial purposes. It is used for its wonderful healthy properties. Juniper is used for improvement of digestion and blood circulation. It is an amazingly diuretic medicine. Its essential oils have high pharmacological importance and industries are using it on large scale for production of different anti-biotics. It also shows the significant anti-septic, anti-inflammatory, anti-microbial and anti-oxidant activity. It is also used for aromatherapy. It works as insulin for diabetes and thus acts as anti-diabetic too.

References

[1] C. Schulz, P. Knopf, T. Stützel. (2005). Identification key to the Cypress family (Cupressaceae). Feddes Repertorium. 116(1-2): 96-146.

[2] A. Farjon. (2001). World checklist and bibliography of conifers. Royal Botanic Gardens: pp.

[3] S. Kakkar, S. Bais. (2014). A review on protocatechuic acid and its pharmacological potential. ISRN pharmacology. 2014.

[4] N. Rana, S. Bais. (2014). Neuroprotective effect of J. communis in Parkinson disease induced animal models [MS thesis in Pharmacy]. Pharmacology Department, Punjab Technical University, Punjab, India.

[5] A.M. Seca, A.M. Silva. (2006). The chemical composition of the Juniperus genus (1970–2004). Recent progress in medicinal plants. 16: 401-522.

[6] N. Gumral, D.D. Kumbul, F. Aylak, M. Saygin, E. Savik. (2015). Juniperus communis Linn oil decreases oxidative stress and increases antioxidant enzymes in the heart of rats administered a diet rich in cholesterol. Toxicology and industrial health. 31(1): 85-91.

[7] S. Pepeljnjak, I. Kosalec, Z. Kalodera, N. Blazevic. (2005). Antimicrobial activity of juniper berry essential oil (Juniperus communis L., Cupressaceae). ACTA PHARMACEUTICA-ZAGREB-. 55(4): 417.

[8] M. Höferl, I. Stoilova, E. Schmidt, J. Wanner, L. Jirovetz, D. Trifonova, L. Krastev, A. Krastanov. (2014). Chemical composition and antioxidant properties of Juniper berry (Juniperus communis L.) essential oil. Action of the essential oil on the antioxidant protection of Saccharomyces cerevisiae model organism. Antioxidants. 3(1): 81-98.

[9] S. Bais, N.S. Gill, N. Rana. (2014). Effect of Juniperus communis extract on reserpine induced catalepsy. Inventi Rapid: Ethnopharmacology. 2014(4): 117-120.

[10] A.J. Cichoke. (2001). Secrets of Native American herbal remedies: a comprehensive guide to the Native American tradition of using herbs and the mind/body/spirit connection for improving health and well-being. Penguin: pp.

[11] T.V. Callaghan, M. Johansson, O. Heal, N. Sælthun, L. Barkved, N. Bayfield, O. Brandt, R. Brooker, H. Christiansen, M. Forchhammer. (2004). Environmental changes in the North Atlantic region: SCANNET as a collaborative approach for documenting, understanding and predicting changes. Ambio. 39-50.

[12] A. Roques *Les insectes ravageurs des cônes et graines de conifères en France*; 1983.

[13] J.C. Chambers, S.B. Vander Wall, E.W. Schupp. (1999). Seed and seedling ecology of pinon and juniper species in the pygmy woodlands of western North America. The Botanical Review. 65(1): 1-38.

[14] D. Garcia, R. Zamora, J.M. Gomez, P. Jordano, J.A. Hodar. (2000). Geographical variation in seed production, predation and abortion in Juniperus communis throughout its range in Europe. Journal of Ecology. 88(3): 435-446.

[15] L.K. Ward. (1981). demography, fauna and conservation of Juniperus communis in Britain. Biological aspects of rare plant conservation.

[16] G. Roux, A. Roques. (1996). Biochemical genetic differentiation among seed chalcid species of genusMegastigmus (Hymenoptera: Torymidae). Cellular and Molecular Life Sciences. 52(6): 522-530.

[17] V. Vikberg. (1966). Observations on some Finnish species of Megastigmus Dalman (Hym., Torymidae), including the biology of Megastigmus bipunctatus (Swederus). Annual Entomologica Fennica. 32: 309-315.

[18] A.S. Gardner, M. Fisher. (1996). The distribution and status of the montane juniper woodlands of Oman. Journal of Biogeography. 23(6): 791-803.

[19] C. Pigott, J.P. Huntley. (1981). Factors controlling the distribution of Tilia cordata at the northern limits of its geographical range III. Nature and causes of seed sterility. New phytologist. 87(4): 817-839.

[20] H. Singh. (1978). Embryology of gymnosperms. Encyclopedia of plant anatomy XII. Embryology of gymnosperms. Encyclopedia of plant anatomy XII.

[21] P. Thomas, M. EL-BARGHATHI, A. Polwart. (2007). Biological flora of the British Isles: Juniperus communis L. Journal of Ecology. 95(6): 1404-1440.

[22] A. Fitter, R. Jennings. (1975). The effects of sheep grazing on the growth and survival of seedling junipers (Juniperus communis L.). Journal of applied Ecology. 637-642.

[23] G. Miller, R. Cummins. (1998). Browsing by red deer on naturally regenerated birch and juniper saplings on wintering ground at Glen Feshie. Scottish Forestry (United Kingdom).

[24] A. Appleyard, S. Fitzpatrick, A. McKee, P. Woodruffe. Juniper regeneration in the Porton Ranges.

[25] M. Ilyas, N. Ilyas. (1990). Biflavones from the leaves of Juniperus communis and a survey on biflavones of the Juniperus genus. Ghana J. Chem. 1: 143-147.

[26] D.J. Klionsky, K. Abdelmohsen, A. Abe, M.J. Abedin, H. Abeliovich, A. Acevedo Arozena, H. Adachi, C.M. Adams, P.D. Adams, K. Adeli. (2016). Guidelines for the use and interpretation of assays for monitoring autophagy. Autophagy. 12(1): 1-222.

[27] G. Levekar, K. Chandra, B. Dhar, A. Mangal, R. Dabur, A.M. Gurav, M. Yelne, G. Joseph, B. Chaudhari, T.K. Mandal. (2007). Database on Medicinal Plants Used in Ayurveda and Siddha, Vol. 8. Central council for research in Ayurveda and Siddha, New Delhi. 522-531.

[28] E. Lamer-Zarawska. (1980). Phytochemical studies on flavonoids and other compounds of juniper fruits. Polish Journal of Chemistry. 54(2): 213-219.

[29] A.Y. Gordien, A.I. Gray, S.G. Franzblau, V. Seidel. (2009). Antimycobacterial terpenoids from Juniperus communis L.(Cuppressaceae). Journal of ethnopharmacology. 126(3): 500-505.

[30] H. Medini, A. Elaissi, M. Larbi Khouja, A. Piras, S. Porcedda, D. Falconieri, B. Marongiu, R. Chemli. (2011). Chemical composition and antioxidant activity of the essential oil of Juniperus phoenicea L. berries. Natural product research. 25(18): 1695-1706.

[31] J.D. Scianna. (2001). Rocky Mountain juniper seed collecting, processing and germinating. Native Plants Journal. 2(2): 73-78.

[32] J.J. Schofield. (1989). Discovering wild plants: Alaska, western Canada, the Northwest. Alaska Northwest Books: pp.

[33] D. Bown. (1995). The Royal Horticultural Society encyclopedia of herbs & their uses. Dorling Kindersley Limited: pp.

[34] V. Komarov, R. Ryu, B. Shishkin. (1968). Flora of the USSR, vol IV. Israel Program for Scientific Translation Ltd, Jerusalem. 507-508.

[35] Z.K. Shinwari, I. Khan, S. Naz, A. Hussain. (2009). Assessment of antibacterial activity of three plants used in Pakistan to cure respiratory diseases. African Journal of Biotechnology. 8(24).

[36] R. Phillips, N. Foy *Herbs Pan Books Ltd. London*; ISBN 0-330-30725-8: 1990.

[37] N. Seighali, M. Ghomi, S. Zaker, M. Ramezanighara, P. Karimi. (2011). Medicinal plants diversity in the flora of Langaroud of Iran. Advances in Environmental Biology. 413-418.

[38] R. Morris, Plants For A Future: Database Search Results. In Creative Commons License, England: 2004.

[39] R. Hyam, S. Jury, M. Wood, B. Leadbeater, D. Simpson, P. Cribb, W.T. Stearn, J. Roddick, P.R. Crane, M. Cheek, The Royal Horticultural Society, Gardeners' Encyclopedia of Plants and Flowers; The lichenicolous fungi of Greenland; Nitrogen Fixation with Non-Legumes; Developments in Plant and Soil Sciences, Volume 35; The embryology of angiosperms: a classified bibliography (1965–1985); Algae and Human Affairs; Biology of Seagrasses; Modern methods in

orchid conservation. The role of physiology, ecology and management; Frank Kingdon-Ward, the Last of the Great Plant Hunters; Plant names of medieval England; Natural Product Medicine; All About Angiosperms; Flowering Plants of the Seychelles (An Annotated Check List of Angiosperms and Gymnosperms with Line Drawings); The Herbarium Handbook; Trees of Nigeria; A New Herball; Flora i Vegetació del Montsec (Pre-Pirineus Catalans); Plants vasculars del quadrat UTM 31T CG46: Abella de la Conca; Indicator Plants of Coastal British Columbia; Plankton—A Microscopic World; Plant Polyphenols–Vegetable Tannins Revisited. In Oxford University Press: 1990.

[40] N. Hedge, N. Canopy, N. Walls, N. Wall. Plants For A Future-Database Search Results.

[41] S. Facciola. (1990). Cornucopia: a source book of edible plants. pp.

[42] S.A. Khan, M. Hamayun, H.-y. Kim, H.-j. Yoon, J.-c. Seo, Y.-s. Choo, I.-j. Lee, I.-k. Rhee, J.-g. Kim. (2009). A new strain of Arthrinium phaeospermum isolated from Carex kobomugi Ohwi is capable of gibberellin production. Biotechnology letters. 31(2): 283-287.

[43] E. Yanovsky. (1936). Food plants of the North American Indians. US Department of Agriculture: pp.

[44] C. McKeon. (2015). Juniperus communis: Revisiting use of common juniper for modern culinary uses & producing drought resistant cultivars for evolving markets.

[45] S.B. Glišić, S.Ž. Milojević, S.I. Dimitrijević, A.M. Orlović, D.U. Skala. (2007). Antimicrobial activity of the essential oil and different fractions of Juniperus communis L. and a comparison with some commercial antibiotics. Journal of the Serbian Chemical Society. 72(4): 311-320.

[46] S. Jarić, Z. Popović, M. Mačukanović-Jocić, L. Djurdjević, M. Mijatović, B. Karadžić, M. Mitrović, P. Pavlović. (2007). An ethnobotanical study on the usage of wild medicinal herbs from Kopaonik Mountain (Central Serbia). Journal of Ethnopharmacology. 111(1): 160-175.

[47] A. Angioni, A. Barra, M.T. Russo, V. Coroneo, S. Dessí, P. Cabras. (2003). Chemical composition of the essential oils of Juniperus from ripe and unripe berries and leaves and their antimicrobial activity. Journal of agricultural and food chemistry. 51(10): 3073-3078.

[48] B.M. Damjanovic, D. Skala, D. Petrovic-Djakov, J. Baras. (2003). A comparison between the oil, hexane extract and supercritical carbon dioxide extract of Juniperus communis L. Journal of Essential Oil Research. 15(2): 90-92.

[49] S. De Marino, C. Festa, F. Zollo, F. Rusolo, F. Capone, E. Guerriero, S. Costantini, V. De Felice, M. Iorizzi. (2014). Phytochemical profile of Juniperus oxycedrus ssp. oxycedrus berries: a new monoterpene glucoside and evaluation of the effects on cancer cell lines. Phytochemistry Letters. 10: 152-159.

[50] D. Modnicki, J. Łabędzka. (2009). Estimation of the total phenolic compounds in juniper sprouts (Juniperus communis, Cupressaceae) from different places at the kujawsko-pomorskie province. Herba polonica. 55(3): 127-132.

[51] S. Sati, S. Joshi. (2010). Antibacterial potential of leaf extracts of Juniperus communis L. from Kumaun Himalaya. African Journal of Microbiology Research. 4(12): 1291-1294.

[52] X. Han, T.L. Parker. (2017). Anti-inflammatory activity of Juniper (Juniperus communis) berry essential oil in human dermal fibroblasts. Cogent Medicine. 4(1): 1306200.

[53] N. Orhan, M. Aslan, M. Pekcan, D.D. Orhan, E. Bedir, F. Ergun. (2012). Identification of hypoglycaemic compounds from berries of Juniperus oxycedrus subsp. oxycedrus through bioactivity guided isolation technique. Journal of ethnopharmacology. 139(1): 110-118.