**Editor ID-IIPER1676901527**

**Phytochemistry and bioactivity of *Pyracantha crenulata* (D. Don) wild and cultivated from Uttarakhand: a review**

1Rakesh Kumar Joshi, 2Preeti Rawat

1Department of Education, Government of Uttarakhand, India

2Department of Chemistry, Bhakth Darshan PG Colleg Jayharikahal, Uttrakhand, India

Abstract: *Pyracantha crenulata* (Roxb. ex D. Don) M. Roem. or *Crataegus crenulata* Roxb belongs to family Rosaceae. The genus *Pyracantha* is an evergreen, thorny shrub, and 10 species of the genus known as ‘firethor’ worldwide due to its dense poisonous thorns and it is generally used for fencing purposes. *Pyracantha crenulata* is an evergreen, deciduous, perennial, and thorny shrub, commonly called Himalayan Firethorn or Indian hawthorn or Ghingharu. In India, the plant is distributed in the temperate Himalayas at 900 m to 2400 m altitude and is abundantly found in barren, rocky, and dry grasslands. These reviews summarize all information regarding *Pyracantha crenulata*.

Key words: Antioxidant actitivty, phytoconstituents, *Pyracantha crenulata*

\*Corresponding author Dr. Rakesh Kumar Joshi

E-mail-raakeshjoshi@rediffmail.com, 8958641401

1. **INTRODUCTION**

Herbal medicinal plants or products remain very popular around the world despite the large amounts of conventional drugs to treat several illnesses.Although the number of bioactive compounds can be enormous in different plants, most are still not chemically defined. Despite that, the relevance of medicinal plants and products grows every year mainly due to the low costs when compared to conventional therapies and due to low side effects resulting from their use. According to Botanical Survey of India, Kolkata, West Bengala total of 2,68,600 flowering plants worldwide among them 18,386 (6.84% of world) exited in India. In India, approximately 3000 plants species are known to have their medicinal properties. All of these a total of 2500 plants are of traditional medicine among them 100 plants used regularly. Himalaya is a global biodiversity hotspot with much diversified geographical, ecological and evolutionary factors for species diversity which support 18,440 species of plants of which 25.3% is of endemic. In Uttarakhand a huge wild diversity which occupies 17.3% of India’s total land area including 92.57% area under hills and 7.43% under plains. All of them about 1748 economically important plants reported from Himalaya.

*Pyracantha crenulata (P. crenulata)* (D. Don) *M. Roem* (Syn*.Crataegus crenulata* Roxb.) (Rosaceae) commonly cultivated as an ornamental plant, and grows wild at thealtitude of 900-2400 m in the North-Western Himalaya. The genus Pyracantha is an evergreen, thorny shrub, and 10 species of the genus known as ‘firethor’ worldwide due to its dense poisonous thorns and it is generally used for fencing purposes. *Pyracantha crenulata* is an evergreen, deciduous, perennial, and thorny shrub, commonly called Himalayan Firethorn or Indian hawthorn or Ghingharu. The dense bushy shrub is native to the Mediterranean to cool, subtropical climates of Southeast Asia. Among its many vernacular names like Himalayan Firethorn, Nepalese firethorn or Hawthorn, the plant also known as Ghingaru in Uttarakhand state of India. It is a bushy and dense plant found widely in barren lands. The evergreen plant attains height up to 5-12 feet, branched extensively with lateral dark green leaves and orange-red pulpy berries. The previous analysis published on different parts of the plant showed many bioactive compounds like, vitexin4 rhamnoside, vitexin, leucocynidine, leucoanthocyanidin, flavonoids, flavonol, kaempferol, glycoside, quercetin, beta-sitosterol and oligomericsaponinse. The fruits are full of medicinal properties. It has some cardio tonic activity so it is useful in following cardiovascular disorders- Coronary vasodilator, Hypertension, Cardiac failure, myocardial weakness, Paroxysomal tachycardia, arteriosclerosis. It is also useful in treatment of Burgors disease. Fruits contain anti-oxidant properties which reduced the free radical in our body Barks is useful in prevention of heavy bleeding during menstrual cycle. It holds medicinal utilization in the treatment of cardiac failure, paroxysmal tachycardia, myocardial weakness, hypertension and arteriosclerosis. Besides, the fruits manifest antispasmodic, diuretic, sedative and vasodilatation properties. *Pyracantha* is used for a good soil binder for stabilizing degraded area that is a slope. That is prone to landslide. The fruit of this plant has been used in Garhwal folk and traditional medicine in the treatment of serious health condition like blood pressure, diabetes, heart disorder, hypertension, circulation system especially in case of angina. The fruit is consumed by aged people for rejuvenation and to reduce joint pain and body pain. The fruit powder combined with yoghurt is given to cure bloody dysentery. The leaves possess antioxidant, immunomodulatory and anti-inflammatory activities that are used to prepare herbal teas, sunburn, creams and facial Cream. In Ghingharu vitamin C, vitamin A, vitamin B, vitamin B2, vitamin B12, vitamin E, protein, carbohydrates, fats, and fibers, calcium, potassium are found in Ghingharu. The bioﬂavonoids in most Pyracantha species are quite useful in the treatment of malfunctioning of the heart and blood circulatory system.

1. **MATERIAL AND METHODS**
2. **Literature search and inclusion of the studies**

A literature survey was done in Pubmed, Cochrane, Embase, and Google Scholar databases to find the studies performed with *P.crenulata* and health promoting effects. The keywords that were used in the search were *P. crenulata* and biological activity or phytochemicals or pharmacological properties or antioxidant or anti-inflammatory or antimicrobial or anticancer or health benefits. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. Only studies published in English language were included. The search did not restrict time. Exclusion criteria were non-English language studies, unpublished data, and poster presentations.

1. **DISTRIBUTION AND TAXONOMY**
2. *Pyracantha* species commonly distributed in Himalayan region. In Uttarakhand it is widely

found from 900 to 1500m range in all hill districts like Nainital, Pithorgarh, Champawat, Chamoli, Almora etc. Also it is an important plant in the foothills of the Himalayas and is found in Uttarakhand in Himachal Pradesh and northern eastern state of India and Nepal at elevation off 1600- 2500m.

1. **Plant taxonomy**

Taxonomically *Pyracantha crenulata* plant is found in hill regions at the time of rainy season from June to August in flowering stage. Its habitat is shrubberies, open slopes, cultivated areas, slopes roadsides, streamside among shrubs. The leaves of *Pyracantha crenulata* are dark green in color with the smooth exterior, 2.5- 4.0cm in length and 1.0- 2.2cm in width tapering end. The leaves are rich in antioxidants. Phenolics are one of the components used to make natural herbal tea by local people. The flowers of *Pyracantha crenulata* arewhite colored inflorescence are a compound corymb with many flowers in it. The flowers are hermaphrodite (bisexual) having 20 stamen and one ovary within the center. Every flower additionally incorporates five sepals and five petals. The fruit of *Pyracantha crenulata* area pome type, consisting of pulpy berries. Fruiting happens at some point of the month of July to September in Uttarakhand condition. The berries are small and each berry weighs 250mg. The pome fruit is orange and red and it provides food for various birds. The fruits are edible and rich in sugar and the leaves are used to make herbal tea. Each berry generally contains 5 triangular brown colored seeds, sometimes 3 or 4 seeds are observed and the seeds are covered with a hard seed coat.

1. **Phytochemistry**

All medicinal plants are rich in many essential chemical compounds. The fruits contained proteins, vitamins, sugars, flavonoids, oligomeric proanthocyanidins, tannins, polyphenols, β-sitosterol, esculatin and quercetin. The flowers yielded phenyl ethylamine, Omethoxyphenyl ethylamine and tyamine. The plant possessed 2- phenylchromones and chlorogenic acid. Pyracrenic acid was isolated from the bark. The major fatty acids of seed oil were linoleic, oleic and palmitic acids. Sati et. al 2017 from Uttarakhand reported that leaf and fruit of *Pyracantha crenulata* showthe presence of glycoside, carbohydrate, tennins, amino acids, sterols and terpenoids. The ash value of powder of *P. crenulata* leaf was determine as total ash, water soluble ash and acid insoluble ash was found to be 3.7%. The extractive value of P. crenulata was found to be 12.5% and 15% in aqous and ethanol respectivly and methanolic extract of fruit extract showed 50% phenolic and 35% flavanoid content respectively. Guglani et.al in 2021 from Uttakhand reported chemical constituents from different parts of *Pyracantha crenulata* likethe leaves exhibited maximum phenolic (127.49 mg/g), flavonoid (23.20 mg/g), and tannin contents (152.32 mg/g) followed by the roots. Similarly, the aqueous extract of *P. crenulata* leaves showed the highest antioxidant activity and phyto-constituents followed by roots.



Figure-1 Phytochemical constituents and bioactivities

1. **Different types of bioactivities**

**A. Antioxidant property:** An antioxidant is a chemical that prevents other molecules from oxidation. Oxidation is a chemical reaction in which electrons from a compound are exchanged to an oxidizing agent. These oxidation mechanisms can produce free radicals that could initiate chain reactions, resulting in cell death and damage. Antioxidants present in hawthorn berries are helpful in reducing the damage caused by free radicals. Western herbalists consider the berries as a potent heart tonic that is very useful in normalizing heart rhythm in hypertensive patients. A report from Uttarakhand revealed that the alcoholic extract of leaves exhibited maximum antioxidant activity with the lowest IC50/EC50 value by ABTS (0.029 mg/mL), DPPH (0.047 mg/mL), and PFRAP (0.025 mg/mL) followed by the roots of the plant.

**B. Antibacterial and antifungal activity:** Ethanolicextract offruitof *Pyracantha crenulata* show significant antibacterial activity against *Shingella flexneri*, *Escherichia coli* and *Streptococcus pyogenes* towards meals poisoning micro-organism.

**C.** **Antihypertensive activity:** A study reported from that *Pyracantha* herbal formulation on hypertensive rats. The results of the study confirmed the positive antihypertensive effect of this beverage.

1. **Nootropic agent:** Enhancer: A mixture of Pyracantha and Ginkgo (Ginkgo biloba) leave was

found to enhance brain cell activity and hence to enhance memory and work as a nootropic agent.

1. **Anti-urolithogenic activity:** A study reported that the fruit of *P. crenulata* show antiurolithogenic property of the alcohol and juice extract of against an ethylene glycol induced model in albino rats and to confirm the traditional medicinal use of the plant.
2. **CONCLUSIONS**

*Pyracantha crenulata* is very valuable plants used in many purposes for medicinal uses. Literature survey revealed that the presence of many useful phytochemicals in its leaf, fruit and seed extracts. Popularity of natural products or their derivatives role in disease cure and prevention is increasing worldwide due to fewer side effects. *Pyracantha* is a plant with capability for the improvement of diverse nutraceutical and pharmaceutical products and also has immense potential for the formulation of nutraceutical products of general public importance to be used in various types of diseases like cardiovascular diseases, kidney problem, diabetes etc. Due to various phytoconstituents present in the plant it has anti-inflammatory, antioxidant, antibacterial, antifungal effect. In Uttarakhand it can become a source of income by making different types of useful products from its leaf, fruit and seed by using a huge cultivation of this plant.

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