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Chemical components and bioactivities of *Pyracantha crenulata* (D. Don) wild and cultivated from Uttarakhand, India: A review

Rakesh Kumar Joshi, Lucas Fornari Laurindo and Sandra M Barbalho

Abstract

Uttarakhand has a rich biodiversity of medicinal plants. Aromatic and medicinal plants have played key role in the lives of tribal people living in the Himalayas by supplying products for food and medicine. This review presents a summary of the chemical compositions and different biological activities of *Pyracantha crenulata* (Roxb. ex D. Don) M. Roem. or *Crataegus crenulata* Roxb., which belongs to the family Rosaceae from a wild and cultivated.

Keywords Antioxidant, antimicrobial, phyto-constituents, *Pyracantha crenulata*

1. Introduction

The Indian Himalaya is home to more than 8000 species of vascular plants which, from 1748, are known for their medicinal properties ^[1-2]. The Indian Himalaya is home to more than 8000 species of vascular plants which, from 1748, are known for their medicinal properties ^[1-2]. Higher plants have played critical role in the lives of tribal people who are living in the Himalayas by providing forest products for both food and medicine. Numerous wild and cultivated plants have been utilized as curative agents since ancient times, and medicinal plants have recently gained importance as herbal medicines and natural ingredients for the cosmetic industry. According to the Botanical Survey of India, Kolkata, West Bengal; a total of 2, 68,600 flowering plants worldwide; among them 18,386 (6.84% of the world) exist in India. In India, approximately 3000 plant species are known to have their medicinal properties ^[3]. All of these, a total of 2500 plants are of traditional medicine, among them 100 plants used regularly. The Himalayas is a global biodiversity hotspot with many diversified geographical, ecological, and evolutionary factors for species diversity, which support 18,440 plants, of which 25.3% are endemic. In Uttarakhand, huge wildlife occupies 17.3% of India's total land area, including 92.57% area under hills and 7.43% under plains. All of them were about 1748 economically important plants reported from Himalaya. In India, *Pyracantha crenulata* is grown between 1000–2600m ^[1-3]. In Uttarakhand, it is widely spread in the Nainital, Chamoli, Uttarkashi, Bageshwar, Champawat and Pithoragarh districts. *Pyracantha crenulata*, commonly known as Ghingaru, kingdom Plantae, Family Rosaceae. Among its many vernacular names, like Himalayan Firethorn, Nepalese Firethorn or Hawthorn, the plant is known as Ghingaru in Uttarakhand state of India ^[4-6]. In the hill areas of Uttarakhand, this plant is used for cultivation near the boundaries of farming areas to stop soil erosion in the monsoon season due to its good soil binder capacity and to prevent the entrance of wild animals into farming fields of vegetables and cereals ^[7].

2. Material and Methods

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 phytochemical or pharmacological properties. Only studies in the English language were included. The search did not restrict time. Exclusion criteria were non-English language studies, unpublished data, and poster presentations.

3. Distribution and taxonomy

Pyracantha species are commonly distributed in the Himalayan region. In Uttarakhand,

it is widely found from the 900 m to 1500 m range in all hill districts like Nainital, Pithoragarh, Champawat, Chamoli, Almora, etc. Also, it is an important plant in the foothills of the Himalayas. It is found in Uttarakhand in Himachal Pradesh and northern eastern states of India and Nepal at elevations of 1600-2500 m. Taxonomically, *P. crenulata* is found in hill regions during the rainy season from June to August in the flowering stage [8-10]. *P. crenulata* is a thorny, woody shrub from 2-5 m at the peak. It's far determined inside the foothills of the Himalayas. It is found along streams on the banks of tributaries and in pine and queue forests. Its habitat is shrubberies, open slopes, cultivated areas, roadsides and stream sides among shrubs. The leaves of *P. crenulata* are dark green in color with a smooth exterior, 2.5- 4.0cm in length and 1.0-2.2 cm in width at the tapering end. The flowers of *P. crenulata* are white-colored inflorescences and are a compound corymb with many flowers on it. The flowers are hermaphrodite (bisexual), having 20 stamens and one ovary within the center. Every flower additionally incorporates five sepals and five petals. The fruit of *P. crenulata* is a pome type, consisting of pulpy berries. Fruiting happens at some point in the month of July to September in Uttarakhand. 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 five triangular brown-colored seeds; sometimes three or four seeds are observed and the seeds are covered with a hard seed coat [9-14].

4. Chemical constituents

All medicinal plants are rich in many essential chemical compounds. Previous studies reported that *P. crenulata* is rich in vitamin C, vitamin A, vitamin B, vitamin B2, vitamin B12, vitamin E, proteins, carbohydrates, fats, and fibers, calcium, potassium and some species are rich in bioflavonoids [15-16]. Previous results from whole plant analysis showed that different types of chemical compounds like vitexin, leucocynidine, leucoanthocyanidin, flavanoids, flavonol, kaempferol, glycoside, quercetin, beta-sitosterol, and oligomeric saponins [17]. Quantitative biochemical analysis of leaves extract of *P. crenulata* showed the presence of substantial quantities of carbohydrates, protein, crude, ascorbic acid and fiber and other physicochemical characteristics of the species. The composition of elemental compounds showed the presence of macro and micro-elements such as potassium, sodium, calcium, zinc, lithium, copper, manganese, cobalt and iron. The phytochemical investigations confirm the presence of medicinally active components such as alkaloids, saponins, glycosides, tannins

and phenols [18]. Also another report from Uttarakhand India shows that leaves exhibited maximum flavonoid (23.20 mg/g), phenolic (127.49 mg/g) and tannin contents (152.32 mg/g) [19]. The fruits contain proteins, vitamins, sugars, flavonoids, oligomeric proanthocyanidins, tannins, polyphenols, β -sitosterol, esculetin and quercetin. The flowers yielded phenyl ethylamine, omethoxyphenyl ethylamine and thiamine. The plant possessed 2- phenylchromones and chlorogenic acid. Pyracrenic acid was isolated from the bark. The major fatty acids of seed oil are linoleic, oleic and palmitic acids [20]. Sati *et al.* (2017) from Uttarakhand reported that the leaves and fruit of *P. crenulata* show the presence of glycosides, carbohydrates, tannins, amino acids, sterols, and terpenoids. The ash value of the powder of *P. crenulata* leaf was determined as the total ash, water-soluble ash, and acid insoluble ash were found to be 3.7% [21].

5. Different types of bioactivities

- 5.1 Antibacterial activity:** A study reported from ethanolic extract of the fruit of *P. crenulata* shows significant antibacterial activity against *Shingella flexneri*, *Escherichia coli* and *Streptococcus pyogenes* towards meal poisoning micro-organisms [22].
- 5.2 Antihypertensive activity:** A study reported on a *Pyracantha* herbal formulation on hypertensive rats. The studies' results showed that the positive beverage antihypertensive effect [23-25].
- 5.3 Antioxidant property:** A report from Uttarakhand revealed that the alcoholic extract of leaves of *P. crenulata* exhibited maximum antioxidant activity with the lowest IC₅₀/EC₅₀ value with ABTS (0.029 mg/mL), DPPH (0.047 mg/mL), and PFRAP (0.025 mg/mL) followed by the roots of the plant [18-19].
- 5.4 Nootropic property:** A mixture of *Pyracantha* and *Ginkgo* (*Ginkgo biloba*) leaf was found to enhance brain cell activity and memory and work as a nootropic agent [26].
- 5.5 Anti-urolithogenic activity:** A study reported that the fruit of *P. crenulata* showed antiurolithogenic properties of the alcohol and juice extract against an ethylene glycol-induced model in albino rats and to confirm the traditional medicinal use of the plant [27].
- 5.6 Heart tonic:** 'Hridayamrit' a tonic from *P. crenulata* developed by DRDO is used for heart diseases. The fruits of this plant which look like a mini apple in red color possess cardiogenic, coronary vasodilator and hypotensive properties used for cardiac failure, myocardial weakness, paroxysmal tachycardia, hypertension arteriosclerosis and burgers disease [18-19, 25].

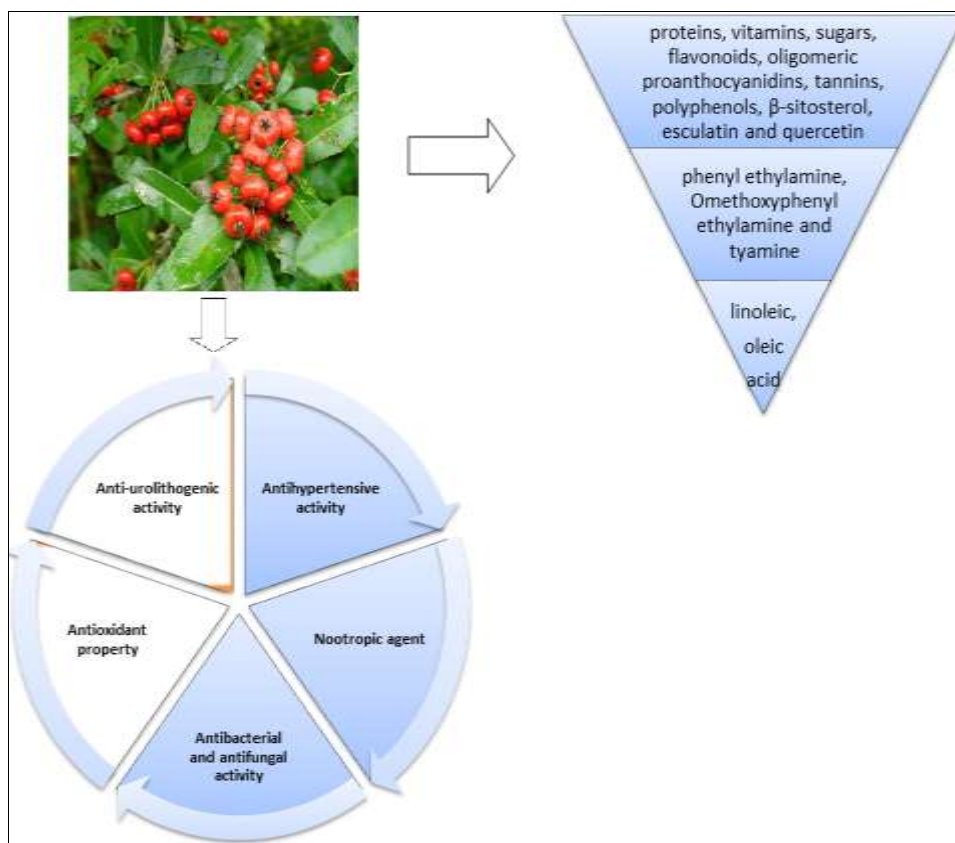


Fig 1: Chemical constituents and bioactivities of *P. crenulata*

6. Conclusions

Pyracantha crenulata is a very valuable plant used for medicinal purposes. A literature survey revealed the presence of many useful phytochemicals in its leaf, fruit, and seed extracts. The 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 the 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 problems, diabetes, etc. Due to various phytoconstituents present in the plant it has anti-inflammatory, antioxidant, antibacterial and antifungal effects. In Uttarakhand, it can become a source of income by making different types of valuable products from its leaf, fruit, and seed by using a huge cultivation of this plant.

7. Author contributions

All authors contributed equally to this work. Rakesh Kumar Joshi, Lucas Fornari Laurindo and Sandra M. Barbalho critically reviewed the manuscript. All the authors read and approved the final manuscript.

8. Acknowledgements

Not applicable.

9. Conflict of interest

The authors confirm that they have no conflicts of interest to declare for this publication.

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